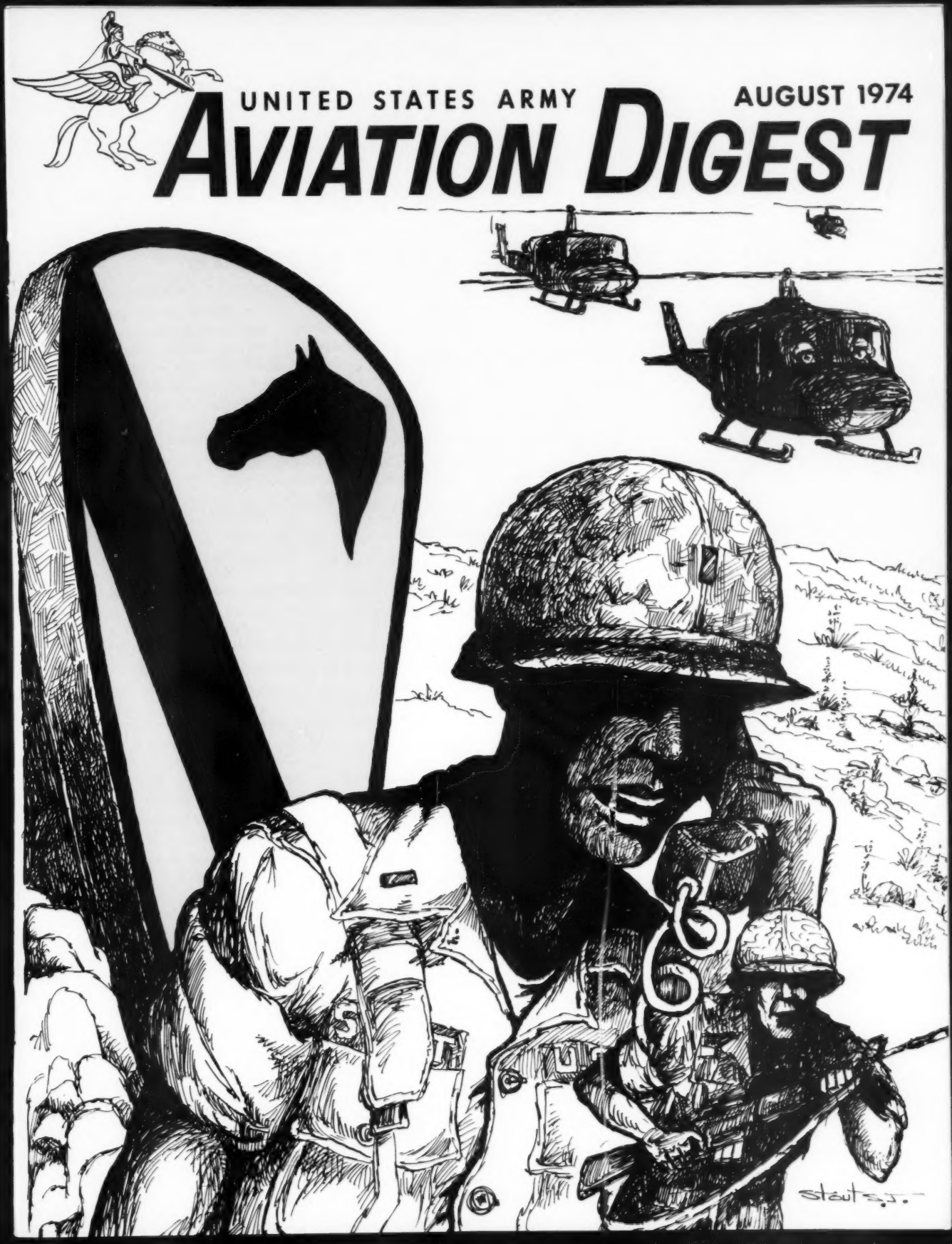
UNITED STATES ARMY
AUGUST 1974
AVIATION DIGEST
stout s.j.

UNITED STATES ARMY AVIATION DIGEST

AUGUST 1974 VOLUME 20 NUMBER 8

Huey Towed Howitzers, MAJ Curtis J. Herrick 2
Operation Mission Completion, CW3 George E. Nicholas 4
MOS Development And Training In Maintenance Support Of Army Aircraft, MG Jack C. Fuson 6
These Are The MASSTER Years, SP4 Clem Hughes 8
Aeromedic 14
ARTS III Comes To Cairns 18
Surveillance At Its Best, CPT Nelson G. Peregoy 20
Army Aviation Hall Of Fame 24
Selected Effects Armament Subsystems 26
AVSCOM Goes NORS To Its Customers, Vernon McGuire, DAC 27
Let's Take A Close Look At Mast Bumping 30
"Hot" Refueling—What You Should Know 34
When Does An Instructor Take Over Controls? 39
Who's Watching The IP? 39
Broken Wing Awards 43
Who's In Command? 44
Pearl's 46
USAASO Sez 48

VANGUARD OF FREEDOM
BICENTENNIAL 1775-1975
UNITED STATES ARMY

COMMANDING GENERAL
U.S. ARMY AVIATION CENTER
MG William J. Maddox Jr.

DEPUTY COMMANDING GENERAL
U.S. ARMY AVIATION CENTER
BG James M. Leslie

EDITOR, U. S. ARMY AVIATION DIGEST
Richard K. Tierney

ABOUT THE COVER

The DIGEST thanks Specialist 6 S. J. Stout for the cover art on the 1st Cavalry Division which is featured this month

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46

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WE IN THE 1st Cavalry Division have had tremendous opportunities to innovate. Our divisional mix includes tanks, mechanized infantry, light infantry, rangers, armored cavalry, air cavalry, attack helicopter units, towed and self-propelled cannon, aerial field artillery and an aviation battalion of three UH-1 Huey companies and one of CH-47 Chinooks.

Every one of our combined arms field problems probes some areas not well covered in published doctrine. On the FIRST TEAM we believe that there is nothing we do which cannot be done better. Our Army has still a great deal to learn about the use of helicopters on the battlefield, particularly in these situations we call a "high air defense environment." The 1st Cavalry Division is sending the DIGEST a number of articles which represent the views of some fine young aviators at a period early in the Army's experience with these complex matters [the first two appear in this issue beginning on pages 2 and 4, respectively]. The subjects range from airmobile maintenance shelters to night airmobile artillery displacements to helicopter operations in the desert. There are no revolutionary concepts surfaced in these articles but they will represent ways and means to accomplish particular tasks as told by people who are doing them. I personally do not agree with all points made. (As a matter of fact, through reading the drafts of these articles I learned that some of my policies are imperfectly understood.) But it's very possible that the authors are right and I am wrong.

While speaking of opinions, I would like to make a couple of points of my own. First, some comments on aviation unit training. In general, it stinks. I am told that some of the major Army stations in the continental United States have such rules as: "Helicopters will not train at altitudes below 100 feet absolute unless undergoing formal nap-of-the-earth (NOE) training." It ought to be obvious that it is impossible to train an air cavalry troop under such restrictions. It is equally true, but perhaps not as obvious, that it is impossible to train a brigade flight section of four light observation helicopters under such unenlightened rules. It doesn't seem logical that day-to-day training should be conducted under archaic rules which don't fit our aviators or their commanders for survival on the high threat battlefield. The problem may be one of education.

If commanders thoroughly understood that their command posts (CPs) will quickly become priority targets of enemy artillery and missiles if several telltale blips on the enemy air defense radar scopes disappear at their CP coordinates, they might be more energetic in requiring aviators to train tactically. Maneuver unit commanders should *demand* that they be delivered to their command posts and fly their command and control (C&C) missions in a way which will not hazard the aircraft or friendly ground units to enemy fire. Commanders and their pilots should plan the route, altitude and speed of every mission in peacetime training just as carefully as if their simulated enemy were real. We simply must make a clean break from the widespread policy of several years ago that a "waiver" is required to train aviation units properly and realistically.

Next, I believe that there is considerable confusion about the definition and standards of NOE flight. Clarity would be improved if in our training a clear distinction is drawn between the individual proficiency of aviators to fly and navigate at slow speeds in very close relationship to the earth (NOE), viz-a-viz the use of that skill in tactical flying. The cardinal rule of flying should be to: Fly at a speed, altitude and ground track which will give the best opportunity for recovery from a catastrophic failure (engine, tail rotor, etc.), while avoiding drawing enemy fire on friendly forces or the aircraft itself.

In unit aviation training no flight or single aircraft should take off without a simulated tactical situation and an analysis by the crew to select suitable flight tactics. For example, if the flight were point to point and solely behind the division rear boundary, 500 feet absolute might be a suitable altitude. A flight from the rear terminating to the rear of the brigade rear boundaries might be able to remain as high as 50 or 100 feet (depending upon enemy radar line of sight). But usually helicopters forward of the brigade rear boundary should be 10 to 25 feet above the terrain, or at true NOE when not shielded from enemy optical or radar observation. The point is we must constantly drill our aviators in the sort of tactical analysis outlined above. This should be our training objective.

I, of course, am not advocating running before we can walk. My major point is that proficiency in individual NOE flying in courses such as those described in TC 1-15 is the *beginning* and not the *end* of aviation tactical training.

MG R. M. SHOEMAKER
Commander
1st Cavalry Division
Fort Hood, TX

[*Editor's note: The Aviation Center agrees with General Shoemaker that TC 1-15 is the beginning and not the end of aviation tactical training. Currently, the Aviation Center is reviewing TC 1-15 with the intention of expanding its coverage into unit NOE training areas.*]

Huey Towed Howitzers

Major Curtis J. Herrick
1st Cavalry Division
Ft. Hood, TX

TACTICS outlook

DURING EXERCISE Gallant Hand '73 an airmobile howitzer battery was overrun by an armored spearhead while CH-47 Chinook helicopters—the prime movers of the artillery pieces—sat fogged in 20 kilometers away at flight idle. Not far from the lost battery was an assault helicopter company with a flyable ceiling in a forward staging area. All the friendly participants listened helplessly as the drama unfolded over the secure radio net. Had the UH-1H Huey helicopters been called while the enemy situation permitted, the howitzers probably could have been moved successfully on a combat risk basis.

Realizing the missed opportunity, Company B, an assault helicopter company of the 227th Aviation Battalion, 1st Cavalry Division, explored displacing howitzers with its H model Hueys. CH-47 artillery operations were studied to take advantage of proven loading and air-ground coordination techniques. The UH-1H operator's manual was searched to determine the aircraft's capability and the suggested flying techniques. The feasibility of the investigations was then checked with a test flight.

The results of the exercise re-

. . . due to weather the artillery's prime movers sat fogged in while an airmobile howitzer battery was overrun during Gallant Hand '73 . . . UH-1H Huey helicopters nearby with a flyable ceiling could have moved the battery on a combat risk basis . . .

vealed that moving howitzers with UH-1Hs is a valid mission that can be accomplished although it induces a higher risk than is anticipated during CH-47 operations. The degree of risk is dependent upon the variables of crew training, wind speed, the outside air temperature and the pressure altitude. Commanders must be aware that above standard day conditions of 59 degrees F. and a mean sea level pressure altitude UH-1Hs may have difficulty making the howitzer lift.

Close coordination with the artillery revealed the airmobile mission requirements. The M102 howitzer, which is supposed to weigh 3,140 pounds, actually weighs about 3,400 pounds. Completed modification work orders and the inclusion of items such as sights and the lifting slings account for the extra weight.

When moving by CH-47 a howitzer battery likes to move with 6 guns, 56 soldiers and about 480 rounds of boxed 105 howitzer ammunition in twelve A22 containers. The weight of two rounds with the packing box is about 100 pounds and the A22 container weighs 36 pounds. In UH-1H operations the ammunition should be carried in the fiber containers to reduce the weight per round to about 45 pounds. With this ammunition configuration the complete battery lift mission should require 24 UH-1H sorties; 16 of the lifts will be devoted to carrying 54 rounds with fuses per aircraft in two A22 bags.

The premission coordination takes full advantage of the efficient ground guide and hookup procedures proven by the CH-47 units moving artillery. The major difference is the emphasis on tailoring the weight of the ammunition loads within the normal Huey lift capabilities, i.e., about 2,500 pounds. This requirement may be simplified in retrograde operations in which fewer rounds are moved to the rear.

In determining the lift capability of a helicopter its basic weight and balance record should be consulted. Like the howitzer, modifications and new items have added to the weight of most aircraft. The crashworthy fuel system is a 160-pound example.

When aware of the actual weight of the aircraft, including the fuel and load, the pilot is then in a position to estimate capabilities of his aircraft to lift the load. Using the outside air temperatures and the pressure altitude as variables, he should consult the lift capability chart in the operator's manual, chart 14-3; there he will learn the

Continued on page 17

1. The weight, temperature and pressure altitude data during the UH-1H's howitzer lifting feasibility check.

a. Weight in pounds	
Pilot (with boots and helmet)	190
Copilot (with boots and helmet)	205
Crewchief (with boots and helmet)	165
UH-1H	5,247
Oil	34
Fuel	700
M102 howitzer	3,400
Total	9,941
b. Outside air temperature	89 degrees
c. Pressure altitude	750 feet

2. The power reading of the aircraft hovering with the howitzer prior to takeoff.

a. Torque in pounds per square inch	45
b. N_1 turbine power reading	97 percent

Operation
MISSION COMPLETION

To qualify Army aviators for their new mission . . .

CW3 George E. Nicholas
1st Cavalry Division
Ft. Hood, TX

IN THE REPUBLIC of Vietnam the Army aviator arrived qualified for the mission at hand. He had all the necessary aircraft qualifications and a basic understanding of the mission to be completed. There was no need for a thorough knowledge of the enemy's aircraft, armor or artillery for these were practically nonexistent. He was participating in a "brush war" in which all the advantages were his —he had few enemy aircraft and relatively unsophisticated antiaircraft and artillery weapons with which to contend.

Now we undergo a complete change in location, time and thus a different type of potential combat operations: the Mid-East or Europe and a conventional high-threat environment. In this new locale the attack helicopter aviator arrives with the same qualifications as his brethren who served in Vietnam. Instead of the individual who could quickly and successfully complete the mission in Vietnam, we have a man who is only basically qualified for this different type of combat.

What has caused this change in operational capabilities, considering that the aviator qualifications are nearly the same? There have been many contributing factors.

In Vietnam the enemy did not generally have modern hardware and when he rarely did appear this hardware was in limited quantities. Specifically, enemy aircraft were scarce; armored vehicles were few (even during the invasion of the I and II Corps in 1972); and his antiaircraft and artillery weapons were relatively unsophisticated.

In the conventional high-threat environment enemy aircraft, armor, artillery and antiaircraft weapons will be major factors—as was demonstrated in the Yom Kippur war in the Middle East last October. During this 18-day war the Israelis lost about 4,100 men, 840 tanks and 114 aircraft; the Arab forces lost approximately 14,800 men, 1,875 tanks and 465 aircraft (figures are based on estimates reported in U. S. news media).

There are numerous geographical areas to which the attack helicopter unit potentially may be deployed. Unfortunately, the forces we may confront in various areas do not all have the same type of equipment nor do they use similar tactics; the equipment and tactics of our allies also will vary. Many of our allies, as well as some threat forces, are recipients of our military aid and schooling. In addition, some (both allied and threat) procure similar types of equipment from other sources. This compounds the problem of the attack helicopter aviator's ability to identify all types of military hardware, both friendly and otherwise—a matter of utmost importance for successful mission completion and compilation of accurate intelligence data. The attack helicopter aviator will require additional training to enable him to successfully complete his mission in a conventional high-threat environment.

During flight school academic instruction at a very basic level should present the aviator with an initial orientation of allied and enemy equipment, tactics and doctrine. This instruction would be for all aviators with further training to be conducted at unit level after graduation from flight school. The amount of advanced training will be determined by the type unit and its mission.

Advanced training in the attack helicopter unit should be completed in several phases—the first

being specific instruction in the attack helicopter unit's mission and tactics. This knowledge of the assigned mission and tactics is the foundation upon which all further knowledge will be based. After aviators learn the role of the attack helicopter in the conventional high-threat conflict, familiarization with the roles of other elements employed within the combined arms team will highlight the strengths and weaknesses of the attack helicopter. This also will provide a stronger working knowledge of U. S. armed forces equipment, tactics and doctrine.

The next phase of instruction would concentrate on combat equipment, basic tactics and doctrine, equipment markings and a thorough familiarization of the assets of allies and potential enemies.

Aviators rated prior to the implementation of the new training program would be required to undergo a modified training program at unit level; the amount and type of training would be determined by the unit and its mission.

Basic and advanced instruction should be reinforced by annual updates of information and testing. A tactics training record would be kept on each individual so that upon his transfer the gaining unit knows the current status of combat training completed by incoming aviator personnel. This program would enable the attack helicopter aviator to be mission-ready upon arrival in a conventional high-threat environment.

A variety of training aids would be needed for full implementation of the training program. Films of normal operations and field exercises would allow an "eyeball" view of equipment and some of the tactics used by each country. For continued familiarity and updating of information, identification charts with three view profile drawings would be very valuable. These charts would be identified by country with the types of equipment listed in the same sequence on each chart. To supplement each chart, provision would be made for a book containing North Atlantic Treaty Organization (NATO) and numerical designation, identifying features, weak points and the quantity of equipment in active forces and in reserve.

Comparative information books or charts would simplify identifying allied and enemy equipment which have similar roles and capabilities. This information would point up the strengths and weaknesses of various armed forces and allow a greater understanding of why certain tactics are or are not used. Further distribution of existing material (i.e., AF manual 50-13, FM 44-30, etc.) also would be completed.

Flash cards or 35 mm slides could be used to check the proficiency of attack helicopter aviators to identify various items of military equipment, both friendly and threat. This is a system already in use by the U. S. Air Force and U. S. Army air defense units.

The concepts for this proposed training program are an outgrowth of personal experiences that I have had during my present tour at Ft. Hood, TX. On numerous occasions I have identified U. S. military equipment by identification numbers and have been asked what I was talking about. When I was talking about foreign equipment, the number of people who could identify the equipment was few indeed.

During a recent field problem I heard the following conversation between a platoon leader and two scout pilots:

"Yellow Scarf 26, this is Yellow Scarf 51."

"Yellow Scarf 51, this is 26, go ahead."

"26, this is 51. We have six big boys (tanks) at Jackson's Crossing heading north, over."

"51, this is 26. Are They Sheridans or M-60s? Over."

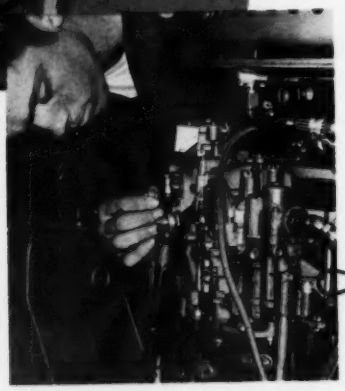
There followed a long silence, finally broken by:

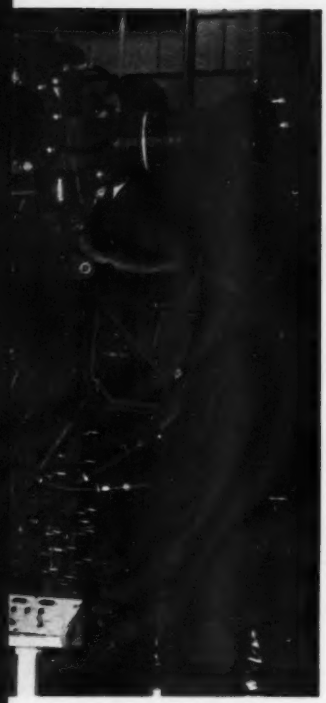
"26, this is 51. Can you tell us the differences?"

It is a funny story to tell, but how funny would it have been in actual combat? About as funny as a couple of incidents that actually occurred during the Yom Kippur conflict. Both the Israelis and Egyptians shot down some of their own Mirage IIIs. To prevent a recurrence, the Israelis marked their Mirages with large yellow splotches on the top and bottom of the wings. The Egyptians' corrective action was somewhat different. They ordered their fighter aircraft to stay out of range of their own air defense artillery batteries. This solved one problem but denied the Egyptian ground forces the benefit of air support from these fighter aircraft.

Future conflicts in which our armed forces participate will likely occur in a conventional high air defense environment. We can anticipate that the enemy forces will be highly trained and that they will employ very sophisticated equipment. In order for our military forces to operate successfully in this environment, our combined arms team, specifically the attack helicopter crews, must acquire a thorough knowledge of the tactics, equipment and capability of our own forces and our adversary as well.

CW3 Nicholas is a Senior Army aviator and a graduate of the Aviation Warrant Officer Career Course. He is an attack helicopter section leader and is in charge of the AH-1Q Cobra/TOW training program for his unit—the 7th Squadron (Attack Helicopter), 17th Cavalry, 1st Cavalry Division, Ft. Hood, TX





MOS Development And Training

In Maintenance Support Of Army Aircraft

Major General Jack C. Fuson
Commandant, U. S. Army Transporation School

This is the third article in the series by General Fuson on the role of the Transportation Corps and its impact on the future of Army aviation. Elimination of production bottlenecks and the consolidation of skills needed to meet the support responsibilities of UTTAS, ASH and HLH are discussed as a part of the restructured training program at the U. S. Army Transportation School

TACTICS outlook

DESPITE THE VALUE of computer technology, the final choice among maintenance alternatives is a human decision. Computer evaluation techniques only provide a basis for making decisions between alternatives and the relative extent to which they achieve the objectives. If the consequences of a maintenance action could be stated in terms of a single value (such as availability, safety, economics, etc.), then the decision problem would be simple. In most cases, however, decisions must be made between alternative actions and sometimes conflicting goals, including tactical requirements virtually dictating decisions. Such decisions, therefore, must be made with a sophistication of judgment that is seasoned by a broadbase of technical knowledge and complete familiarity with the Army aircraft maintenance and support environment. To assure that the most appropriate decision for a particular situation is made by aircraft maintenance personnel, a number of actions have been taken by the U.S. Army Transportation School at Ft. Eustis, VA.

First, the emphasis on particular skills and knowledge has been shifted to better correlate with today's maintenance environment. The duties of airplane and helicopter repairmen within the career management subfield 671 for aircraft maintenance have been realined toward "systems" maintenance with significant increases in system diagnostic and prognostic responsibility. This concept was reflected in changes to job descriptions that became effective in November 1973. Under this concept, training will be oriented to the maximum degree on the early detection of faults that affect safety of flight. Additionally, personnel will be trained to quickly analyze and trace the cause of equipment malfunction to identifiable modules using applicable technical manual troubleshooting instructions and easy to interpret go/no-go built-in test equipment (BITE); installed aircraft instruments; or easy to use/interpret, diagnostic/fault isolation devices.

Secondly, training programs are being restructured to conform with the changing maintenance environment. The 671 career subfield of aircraft maintenance is not designed to recognize differences in organizational or support levels of maintenance; however, training emphasis is being placed on those tasks associated with rapid maintenance response. Replacement functions at user level are limited to the removal/installation/reinstallation of worn or damaged modules which do not require

Continued on page 28

THESE ARE THE MASSTER YEARS

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Specialist 4 Clem Hughes
MASSTER Information Office
Ft. Hood, TX

Above, Cobra/TOW operational test by MASSTER. Aviators are from the 7th/17th Cavalry

Right, AH-1Q Cobra/TOW helicopter is readied for additional armament system tests

Far right, it's not a spaceman. A MASSTER test officer models AN/PVS-5 night vision goggles

MASSTER tests new ideas, equipment and concepts with troops in field situations searching for ways to enhance and improve Army aviation operations. A major effort begun in 1971 was directed toward the development of the air cavalry combat brigade; one such brigade now exists within the 1st Cavalry Division. Several other MASSTER projects are discussed showing how the researchers are seeking answers and solutions to future needs of Army aviation

THE U. S. ARMY's use of the helicopter in the Republic of Vietnam in the 1960s proved the versatility of the rotary wing chariots and the men who flew them.

The AH-1 HueyCobra, the UH-1 Huey, the OH-6 and OH-58 LOHs and the CH-47 Chinook — all came out of Vietnam and entered the 1970s with impressive combat records and a more or less standard manual of procedures and tactics that were used during combat operations in the Far East. But to the aviation researchers and thinkers who must gaze into the future and think of things that might be, Vietnam is now only a memory. The future demands the development of new airmobile doctrine, emphasizing nap-of-the-earth (NOE) tactics.

For years now various agencies of the Army have been studying that concept of military operations that is known as airmobility. Every day somewhere in the United States there is someone or some group thinking of new and different ways to improve tactics, doctrine and concepts to keep Army aviation directed toward the future.

And one of these groups examining the entire spectrum of Army air operations is MASSTER—the Modern Army Selected Systems Test, Evaluation and Review—located at Ft. Hood, TX.

When MASSTER was created in October 1969 it had a different name and a different job. It was known then as the Mobile Army Sensor Systems Test, Evaluation and Review, and its job was to quickly and efficiently evaluate surveillance, target acquisition and night observation (STANO) equipment that was destined for use in Vietnam.

However, in 1971 the mission of MASSTER was significantly altered, the name was changed to its present reading, and one of MASSTER's new goals was to study the role of Army aviation in a high air defense environment of mid-intensity conflict.

In its simplest definition a mid-intensity conflict is warfare similar to that of World War II and perhaps more closely related to the recent major fighting in the Middle East. The high air defense threat environment was experienced in the Yom Kippur war. Vietnam was a low-intensity, guerrilla-war affair. A high-intensity conflict could involve the use of nuclear weapons.

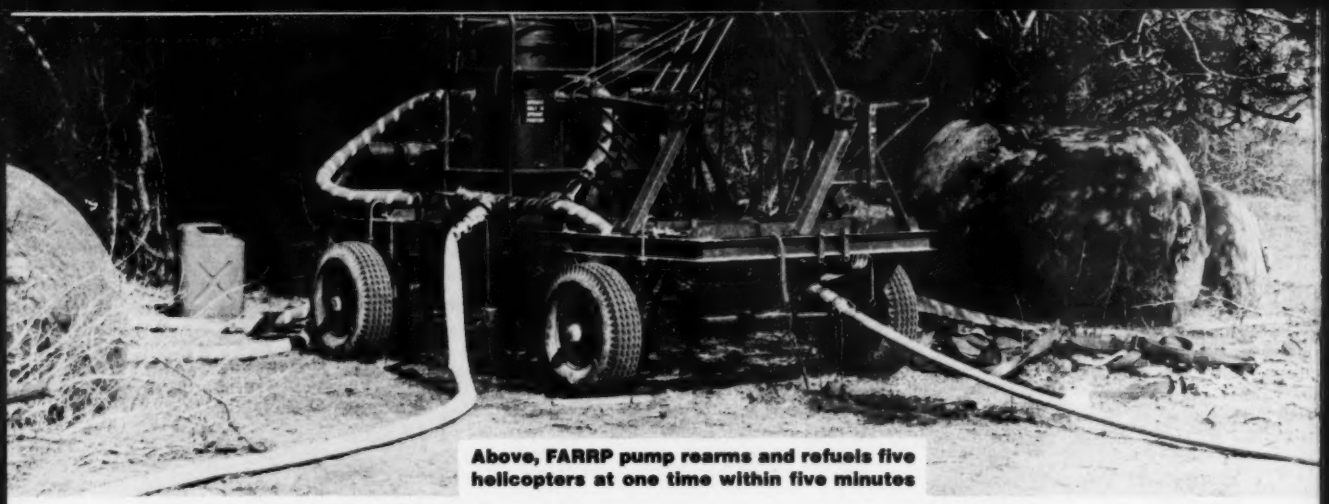
As Major General Herbert J. McChrystal Jr., the deputy commander of MASSTER, frequently points out, "Adapting the Army for a mid-intensity conflict involves changing a lot of ideas and attitudes. For example," General McChrystal relates, "a whole generation of Army aviators and tacticians got their basic education in Vietnam and are oriented to Vietnam-type action. However, those basic tactics may have to be altered in a mid-intensity conflict because our side may not have air superiority all the time, and we may have to face an opponent who is numerically as strong and equipped with the same technologically-advanced devices that we have.

"Even in the area of camouflage, for instance, it's easy to see that the Army as a whole is not geared to concealing the individual soldier, our command posts, our vehicles or our aircraft from the enemy's view," the general continued. "And the list of subjects that must be adjusted to 'mid-intensity thinking' is almost endless."

In recent years MASSTER has been—and is—involved in many projects that may affect the tactics of the Army in the future, both on the ground and in the air. But at MASSTER the object is not just to think of new ideas and try them out in the "laboratory." Rather, MASSTER is set up as a field test agency and conducts its tests of new ideas, equipment and concepts with troops who may eventually employ those new developments. For that reason MASSTER testers have drawn heavily on the manpower and skills of the 1st Cavalry Division (Airmobile) and the 2d Armored Division at Ft. Hood to test everything under actual working conditions. The handiness of the two combat divisions also makes it easy to conduct tests on a large scale with division tactics involved.

And by using the aviation assets of the two divisions, MASSTER's Air Combat Directorate is leading the search for new and different ways to enhance and improve Army aviation operations.

The Air Combat Directorate's mission is to plan, design, conduct, evaluate and report on assigned tests, experiments and studies of



Above, FARRP pump rearms and refuels five helicopters at one time within five minutes

selected materiel, proposed systems, organizations and tactical concepts. With this broad mission the directorate has conducted a number of tests involving the tactics and organization of aviation units.

"Our major efforts in this area have been directed toward the formation of an air cavalry combat brigade that uses the Cobra as its attack weapon," explained John F. Nutt, a military plans analyst with the directorate. "Our testing began in 1971 with the creation of an air cavalry attack platoon. Subsequent tests in 1972 and 1973 then examined the organization at the troop and squadron level.

"In each of the field exercises, the different air cavalry organizations were observed in terms of their structure, employment doctrine, support requirements and the impact of electronic warfare on operations.

"Valuable lessons were learned in each test, and necessary changes were made for the succeeding test," Mr. Nutt continued. "Then, to wind up the air cavalry experiments, a major brigade-sized test —the Air Cavalry Combat Brigade (ACCB)—was slated for early 1974, but national fuel considerations caused cancellation of that test."

However, the earlier findings by MASSTER apparently proved the worth and capability of an ACCB in a mid-intensity conflict, and the ACCB is operating as one of the brigades within the 1st Cavalry Division.

The question of battlefield survivability of the helicopter also has been studied by MASSTER's aviation specialists within the Air Combat Directorate and as a result extensive development of doctrine for NOE flying was forwarded by MASSTER.

With NOE techniques a pilot flies as close to the ground and any obstacles as he can—3 feet is considered a good working level by MASSTER. Tests reveal that few radars can effectively track a helicopter flying at low speeds at this level when an aviator literally hides behind trees, buildings, hills or whatever may be handy.

NOE flying does not have to be limited to daytime activity, as test officers in the directorate are quick to point out.

By using the AN/PVS-5 night vision goggles (NVG) used in the Combat Air Vehicle Navigation and Vision System (CAVNAVS) obtained by the Army Materiel Command (AMC), a pilot can turn night into day at ranges up to 3,000 meters depending on the light level (see "Helicopter Low Level Night Operations" and "How Night Becomes Day," May 1973 DIGEST).

The NVG is a goggle-like device that fastens to the helmet and gives the wearer a bug-eyed, unearthly appearance. The goggles work on a light amplification principle, much as in the familiar Starlight Scope. After a short training period aviators adjust to the green-tinted view and fly almost as low and as fast at night as they can in daylight.

Another unique device tested by MASSTER is the electronic location finder (ELF) system developed to satisfy a U. S. Air Force requirement to assist search and rescue helicopters to quickly locate downed aircrewmen.

"The ELF system was used in Vietnam frequently," according to Mr. Nutt. "There a downed pilot would turn on the device and a reconnaissance plane would be flown over the area until it homed in on the target. Since the canopy in jungles is like a foggy condition, direct visual observation is almost impossible, but the ELF helped determine the information needed for a landing."

MASSTER tested the system to determine the feasibility of executing vertical landings and take-offs under instrument weather conditions with ELF equipped helicopters.

Another MASSTER project, named Quick Draw, examined the capability of the Vulcan self-propelled air defense artillery system and the M-60 tank system, using its cupola-mounted .50 caliber machinegun and main gun to detect, engage and hit attack helicopters operating at nap-of-the-

earth levels. During the test, live fire was employed from the ground against balloons simulating the size and location of airborne helicopters. The balloons would pop up at different distances from the tanks and remain in position long enough for a pilot to fire a barrage of rockets. In Phase II of the testing helicopters conducted live fire on ground targets which represented armored vehicles.

The results of the Quick Draw testing showed MASSTER researchers a lot about the distances at which an attacking helicopter is fairly safe from direct ground fire. Also, firing done by helicopters provided new information about the ranges at which various rotary wing aircraft can effectively saturate a target area with rockets.

The question of effectively refueling and rearming helicopters close to the battlefield in a mid-intensity situation also has been examined closely by MASSTER's researchers. The result of the study was development of an FARRP—forward area rearming and refueling point—which can reload and refuel five helicopters simultaneously in a 5-minute period.

The five-point refueling system was designed for MASSTER by AMC. There are two versions of the system, gasoline and electric. With either, one man can operate the refueler—as opposed to the three men needed to simultaneously refuel five aircraft using the standard two-point system with which most aviators are familiar.

The material used in the present FARRP configuration is an MJ-15 materiel handling device that is basically a 3,500 pound, low-silhouette forklift. The MJ-15 can tow a 500 gallon blivet of JP-4 fuel and pick up a ton of ammunition at the same time, making it a handy piece of equipment.

However, the earlier tests of the FARRP resulted in a number of recommendations that will require the Air Combat Directorate and MASSTER's Combat Service Support and Special Programs (CSS&SP) Directorate to continue tests through this summer.

One of the new ideas being incorporated into the FARRP is a coupling device that uses electric power from the aircraft being refueled to power the fuel pumps. In the ammunition loading part of the FARRP, new techniques for packaging and storing 2.75 inch rockets, 40 mm grenades and 7.62 mm ammunition also will be evaluated.

"Another area in which we have posed several questions is that of aerial weaponry, because it is safe to say that not a great deal of progress has been made in arming the attack helicopter," said Major Harry L. Landis, an Air Combat Directorate test officer. In the 1950s and 60s the Army evaluated a variety of rockets being fired from UH-19s, CH-21s and CH-34s. Machineguns and rockets also were fired from OH-23s, OH-13s and UH-1s and M-22 and TOW (Tube launched, Optically tracked, Wire guided) missile-equipped UH-1 helicopters have been used, but the best bet to date seems to be the 2.75 inch rocket. "If we had to go to war tomorrow that is the system upon which we would have to rely," Major Landis said.

MASSTER has conducted rapid firing exercises with the 2.75 inch rocket to develop techniques for its employment against massive armored attacks. The 2.75 inch dual purpose—antiarmor and antipersonnel—warhead, coupled with the technique of several AH-1 Cobras unloading up to 380 rockets into a target area in less than 2 seconds, should continue to be useful for some time to come.

MASSTER researchers recently have evaluated two similar prototype devices that may help a Cobra pilot control and mix the store of 2.75 inch rocket ammunition carried in his pods. Both of the new systems allow a pilot to select, arm and fire his rockets in a variety of ways:

- He can select any rocket from a pod to be fired with a rocket from any other pod.
- He can remotely set the fuzes for an airburst or penetration.
- He has three different time settings between firings he can select, according to the target and other conditions.

Helicopter wrapped in new plastic cocoon. Test for degree of protection from rust, corrosion and salt spray

• The rockets can be fired individually or in combination of numbers up to 19 at a time.

MASSTER is conducting an operational test of the Cobra/TOW armament system. "We are evaluating the effectiveness of the AH-1Q in a user unit," Major Landis said, "to include such categories of information as adequacy of logistical support, training, organization and techniques of employment."

Eight AH-1Qs have been furnished for the test and will fire up to 100 TOW missiles, 750 2.75 inch rockets and several thousand rounds of 40 mm and 7.62 mm minigun rounds.

"But no matter how versatile the Army makes the basic 2.75 inch rocket system or how effective the TOW may prove to be, we will still need a true fire-and-forget missile in the future to allow our helicopters to attack point targets at ranges of 2 or more kilometers," Major Landis added.

Another task MASSTER is attempting to solve is moving a helicopter after it has landed. To do this, MASSTER testers have tried using various types of transporters, including motorized ground handling wheels, a capstan winch system and a tracked, battery-operated helicopter transporter.

Additional testing of the helicopter ground movement systems will examine the mechanical capabilities, the repair requirements and safety and human factors involved in operating each system. Also, the mobility and transportability of each device is being studied.

Captain Preston Forsythe, a test officer in the CSS&SP Directorate, said, "Of course, there are several methods now being used to move helicopters on the ground, but all are for use on hard, smooth ground. They are not designed to carry heavy helicopters over unimproved, rough terrain and in a combat situation there may be a need to move helicopters quickly so they can be hidden and camouflaged under a group of trees. There is no effective way to do this currently."

All of the ground movement systems and devices are prototype items, and because of the unknown abilities of the different systems the tests are being conducted with unserviceable and unrepairable helicopter hulks. This way, if the helicopter hulks are damaged by any of the experimental systems, nothing is lost and MASSTER researchers can gain a lot of information about the equipment being used.

A new method to prevent rust and corrosion on helicopters that are in storage and not serviced frequently also is being examined at MASSTER. The test involves sealing a helicopter inside its own airtight plastic "cocoon."

The cocoon is a polyvinyl chloride plastic that comes in four custom fitted sections that join together with a plastic zipper to seal out air. Some tape is applied around the legs of the helicopter's skids to complete the sealing process. Also, a special dehumidifier/heater is placed in the cabin of the helicopter to heat and recirculate the air inside the helicopter. A control box outside the helicopter enables servicemen to monitor the humidity level inside the plastic covering and control the humidifier. Ideally, the humidity is maintained at 40 to 45 percent.

"Our major concern right now is with a system to protect helicopters while they are in storage in a warehouse or in the open," said Major Kurt Beilharz, another test officer from the CSS&SP Directorate. "Also, we want to find some way to protect them when they're being transported by ship and exposed to salt water spray."

In March 1972 the Vice Chief of Staff of the Army, General Bruce Palmer, directed MASSTER to take the leading role in the development of innovative camouflage techniques. The task of handling the mission fell into the hands of MASSTER's CSS&SP Directorate. A portion of this evaluation deals with the camouflage pattern painting of helicopters.

The basic camouflage pattern and colors were designed jointly by MASSTER and MERDC (U. S. Army Mobility Equipment Research and Development Center) to disrupt the identifying characteristics of shape, shadow and high-

Rough terrain motorized ground handling wheels are set in place by two soldiers at MASSTER

lights of the fuselage, thereby making aircraft more difficult to detect and identify.

This disruption is accomplished by using *color* to reduce contrast with the surrounding environment; *pattern* to disrupt the geometric line and overall configuration; and *lusterless lacquer* paints to reduce glare.

"The test pattern under evaluation by MASSTER is unique," explained Major Richard McDermott, the camouflage project officer. "A specific pattern was developed for each type of aircraft. The basic design of the pattern remains constant; however, the color within the pattern can be changed to accommodate the vegetation and terrain of most geographic areas."

For example, the colors used in the pattern to fit the Ft. Hood area consist of 40 percent forest green, 40 percent field drab, 15 percent sand and 5 percent black.

"Pattern painting of helicopters reduced the ability of observers to detect and recognize the aircraft when viewed against certain terrain backgrounds," continued Major McDermott. "This applies when the aircraft was on the ground and when flown at NOE altitudes. Pattern painting also provided an excellent base for further, more complete camouflage while the aircraft were on the ground."

Equipment designed to reduce the glint and glare from helicopter canopies also is being evaluated. The canopy glare cover consists of either muslin or "rip stop" nylon material that is cut to the same dimensions as the canopies of the AH-1, OH-58 and UH-1 helicopters. The cover fits over the aircraft like a sock and extends toward the rear to cover all canopy sections. It is secured to hard points on the fuselage and designed to be used in conjunction with pattern painting. Color patterns have been applied to the covers to correspond with the pattern on the fuselage. The material provides a textured surface and the weight of the cover varies with the type of material used and the size of the helicopter.

"The camouflage helicopter canopy glare cover provides an effective concealment for parked helicopters," said Major McDermott. "The cover can be carried onboard and permits easy, quick attachment and detachment. Its bulk and weight are minimal."

Major McDermott's outlook toward aircraft camouflage is optimistic. He said, "Most of our new concepts are good. In the future we may be looking at build-in adaptations for aircraft camouflage. We have come a long way with camouflage materials and techniques, and we have discovered what routes we must undertake for new and better ideas in camouflage.

"To be practical, in a tactical situation the final product must be inexpensive, effective and quickly set up," he continued, "but it will take time to develop a materiel item from feasible concepts.

"We try to look at aircraft camouflage from two points of view," Major McDermott concluded. "By the use of camouflage pattern painting on the helicopter hub, rotor and fuselage area, we increase the survivability of the aircraft. But we need to have flexibility and mobility with helicopters to camouflage the aircraft where it has landed, or to move it to a prepared camouflage position."

So the search for answers to questions continues at MASSTER —answers to questions about helicopter camouflage, about aerial weaponry, about refueling and reloading, about attack helicopter tactics, about ground movement of helicopters. The list of questions is endless, but MASSTER researchers are seeking answers and solutions, while keeping an eye on the future and doing their part to develop a better Army aviation program.

A tracked, battery powered helicopter ground handling transporter is tested by a soldier participating in MASSTER

Human Factors In Nap-of-the-Earth Flying

Lieutenant Colonel Nicholas E. Barreca, M.D.

Aeromedic

Provided by the Society of U. S. Army Flight Surgeons

Part III. Flying Fatigue

EACH OF US RECALLS the early days of pilot training. Some have more recent recollections, others have to dig deeply to refresh bygone memories. Whether in fixed or rotary wing aircraft, all can remember the excitement, apprehensiveness, the overwhelming awe, humility and frustrations of those embryonic hours of flight training.

Perhaps with some honest reflection, many can recapture the hours immediately after those thrilling early flights and the evenings that followed. There was that sensation of relief and gratitude. Then a feeling of exhaustion, loss of energy . . . that depleted, spent, rung out feeling as if someone had set upon your adrenal glands* and forgot to get up. That was and is fatigue.

Recently, a group of experienced Army aviators returned from flying an experimental nap-of-the-earth (NOE) course. They were subjects of an investigation to determine the effects of NOE flying on aviator performance. Most of these aviators experienced that rung out feeling after extremely short, repetitive runs on a demanding NOE course.

There is no doubt that operational NOE flying will be fatiguing. Fatigue has been a particular concern of commanders, safety officers, flight surgeons and aviators since flying began. In NOE flying it will be an ever present threat and bedfellow. Nap-of-the-earth flying is a demanding task master. It takes complete and unwaivering concentration. It requires the utmost in preparation and forethought. It must be anticipatory and predictory, perhaps to some extent even visionary. It must be flexible, thoughtful, calculating and coordinated. In the face of all these mental aerobatics, it requires continuous and unconscious coordination of flight controls to produce the desired and ever-changing flight path. For flying performance to be safe, efficient and effective, painstaking care, planning and consideration must go into determining the utilization of flight crews.

Fatigue has always been a difficult entity to define and measure. Perhaps the best working definition is as follows: *Fatigue is a detrimental alteration or decrease in skilled performance related to duration or repetitive use of that skill, aggravated by physical, physiologic and psychic stress.* Fatigue is a difficult condition to measure. It is variable from individual to individual and over time. It can be influenced and altered by a myriad of conditions.

There are many biochemical and cardiovascular measures of man's reaction to stress. Each requires foreknowledge of the individual and utilization of extensive laboratory equipment and analytic techniques. None are truly predictive of efficiency or effectiveness of performance. The U. S. Army Aeromedical Research Laboratory at Ft. Rucker, AL, has performed some preliminary experiments comparing these indices among aviators engaged in both normal, uncomplicated flight and nap-of-the-earth flight. Early examination of results seem to indicate biochemical and cardiovascular evidence of significantly increased stress during nap-of-the-earth flying.

The most important index however is performance. Since nap-of-the-earth flying *is* stressful, what does it do to performance over time? Several years ago flight

***The adrenal glands of the body sit atop the kidneys and are responsible for producing many hormones including those required to face stressful situations of fight or flight. The flight referenced to here is one of departure or escape from a stressful situation.**

surgeons at Ohio State University decided to study the effects of fatigue in terms of operational flying performance. They rigged a helicopter electronically so that movement of the three major controls—throttle, cyclic and collective—as well as rotor rpm, could be monitored continuously in flight. They were primarily interested in determining the movement of these controls around a given neutral position over time, while pilots flew predetermined aerial observation missions at assigned altitudes and airspeeds. In the course of these missions, designed to produce fatigue, pilots tended to allow rotor rpm to vary within wider limits as flight time increased. Control movements of relatively large amplitude increased considerably during the latter hours of flight. The increases in variability of rotor rpm during the fourth hour of such missions were as great as the increases in variability induced by blood alcohol levels of 120 mg. percent in fixed wing pilots who were studied performing a tracking task.

This type of study appeared to have great potential for examination of the effects of fatigue on performance. The examination of control movements with time could give great insight into how and when fatigue was beginning to tell its tale for given aircraft and mission profiles. It could even, once standardized, have the potential for an inflight monitoring system for fatigue (i.e., when the pilot's control movements became unacceptably large a warning signal could alarm the pilot to his impending incompetence).

With the arrival of nap-of-the-earth, this technique becomes somewhat limited. The hallmark of nap-of-the-earth is changing altitude and airspeed, with frequent and larger movement of controls. Of course, with compensated controls, rotor rpm becomes a less sensitive measure of control. In spite of these limitations, the U. S. Army Aeromedical Research Laboratory is investigating performance data from NOE flying. Using a specially developed flight recorder system, they are monitoring cockpit workloads over time under both day and night conditions in an attempt to determine levels of fatigue. To date, only limited data has been accumulated, insufficient to be conclusive.

How then do we determine when fatigue is a significant factor? Where do we draw the line on frequency and duration of nap-of-the-earth flight? First, one has to be able to recognize flying fatigue when it occurs. The symptoms and signs of both acute and chronic skill fatigue have been examined in a previous article and will not be discussed here (see "Aeromedic—Flying Fatigue," January 1972 DIGEST).

For dawing the line, one must use past experience and common sense. Some experience has been accrued under conditions similar to NOE flying and some guidelines can be offered. This author has acted as a medical advisor to the U. S. Army Precision Demonstration Team, known to us all as the Silver Eagles. In the course of flying with them during their profiles, I have noted certain signs and limitations.

The Eagles fly demanding profiles, not unlike nap-of-the-earth in character. They require constant attention, control movement and anticipation. Flying a near half rotor disc apart, while still performing specific maneuvers (turns, climbs and descents) is no Sunday afternoon picnic affair. One of the earliest signs noted of fatigue was overcontrolling. Early during flight profiles, control movements were almost unnoticeable . . . imperceptibly small. Beyond 90 minutes, particularly after 120 minutes, control movements become more erratic and visible. Yet outside the cockpit, the show appeared as smooth as ever . . . they were perhaps only on the brink of potentially hazardous fatigue . . . the point just before significant performance decrement is likely to occur. Another sign was that of irritability. This became noticeable as breakdown in communications discipline inside and outside the cockpit . . . more chatter . . . commentary about fellow pilots' performance and the like. For this reason, it was recommended that the Eagles fly practice periods no longer than 90 minutes each, twice a day, with at least 2 hours between flights.

How does this apply to nap-of-the-earth? In all likelihood, that same recommendation could be easily applied to nap-of-the-earth flight. The Silver Eagles' aircraft are flown by some of the Army's best and most experienced pilots. Perhaps to accommodate our most inexperienced pilots, 45 minutes per sortie would be a more reasonable limitation, particularly for operational training and particularly at night.

Despite this amount of care, one has to remember that fatigue is an individualistic condition in its development. Even with time limitations, pilots need to be monitored closely by commanders and flight surgeons. These people must participate regularly and frequently in nap-of-the-earth flight if their observations and recommendations will be valuable and useful.

There are some specific conditions of nap-of-the-earth that are likely to produce higher levels of skill fatigue and require special provisions and practices. Nap-of-the-earth flight in tropical climates and warm seasons will be especially fatiguing. There will not be the cooling effect of altitude that was often present in places like Southeast Asia. At NOE altitudes, with the combination of low airspeeds and the greenhouse effect* of helicopter cockpits, there will be high levels of heat stress. The associated salt and water losses and discomfort are likely to hasten the onset of fatigue if not anticipated. Adequate provisions for salt and water replacement, and perhaps even environmental control, will guard against early onset of skill fatigue under these conditions.

At night the special practices recommended in the about to be published DA Training Circular entitled "Rotary Wing Night Flight" will help to minimize fatigue likely to be associated with night NOE. The planning and preparation that goes into NOE night flight will far outweigh the actual flight duration in most instances.

***The greenhouse effect is the buildup of radiant heat in a glass enclosed space exposed to heat energy. This is because the sun's rays pass through the cockpit's plexiglass without difficulty. When this radiation heats up the interior objects of the cockpit, they re-radiate the heat at wavelengths that are unable to penetrate the plexiglass outward.**

What general guidelines and considerations can be embraced as measures to minimize the occurrence and severity of skill fatigue? First of all, there are the guidelines established in AR 95-1. With respect to daily flying hours it states:

> "The maximum number of hours to be flown in any 1 day will vary with the factors affecting safety of operations. They will be adjusted at the local level, based on the type of mission, type of aircraft, operating conditions, weather, time of flight, diet of crewmembers, physiological condition of crewmembers, and rest facilities available."

In other words it has to be individualized by responsible commanders with true concern for the safety of their men.

With respect to longterm stress, the regulation is equally general. It reads as follows:

> "When developing implementation directives, commanders will consider the following:
>
> a. Advice of the flight surgeon and the aviation safety officer in determining limits for specific operations or time periods. In combat, 140 hours per 30-day period is considered a maximum, but may be exceeded when required. As a general rule, aviators flying beyond 90 hours in a 30-day period must be observed frequently by a flight surgeon. . . ."

It is likely that maximum monthly limits will have to be decreased when the majority of the time flown is NOE.

As mentioned earlier in this article, limitation of sortie duration will likely be required. Depending on crew experience and teamwork, NOE sorties should range between 45 and 90 minutes, followed by adequate recovery periods. In addition, there should be rotation of sorties. Crews can fly administrative and indirect support flights in intervening periods. There are the routine "VIP and ash and trash" flights that are not infrequently flown over nonhostile terrain, at higher altitudes, behind the line of engagement. Thus, a commander will have to be an extremely competent manager of personnel, time and resources.

Perhaps the most important prerequisite for minimizing fatigue is continued purposeful training and proficiency. If pilots will fly effectively and efficiently NOE, they must train NOE and maintain their proficiency by continued flying NOE. This means maintaining a professional force of reasonably high time pilots in anticipation of armed conflict. The coordination and teamwork required in NOE will likely not come automatically to veritable strap hangers.

An area that has perhaps been neglected in the past has been the requirements for useful and meaningful relaxation, recreation and physical fitness. It is the strong feeling of this author that these are essential if flying skill fatigue will be minimized in the NOE environment. There are those who will say that there is little hard evidence (that's the scientific, statistically significant type) to demonstrate the effectiveness of these measures. It is true that these elements are highly complex factors to investigate under controlled conditions. However, if we wait for scientific objectivity, we may be paralyzed to inaction. The fact is that we have the knowledgeable experience of the three military services' flight surgeons, most of whom agree to the importance of these factors.

First, there is physical fitness. Many industrial studies to date have demonstrated certain salutary effects of physical fitness. These were observed even among the previously uninitiated. There is an increase in one's physical capacity to perform work, to endure physical and mental stress. There is an increase in self-esteem and self-confidence often reflected in greater competitiveness and boldness. Finally, there is an improvement in an individual's ability to relax, control emotional states and to flat sleep comfortably. What more could one ask for in an NOE pilot? However, physical fitness has to be routine and it has to be supervised (if it will be performed and performed safely).

Then there is that question of healthy recreation and relaxation. Man needs diversion for psychic well-being. He needs to momentarily forget his frustrations and anxieties. He needs to vent and divert his hostilities and aggressions. Unfortunately, in previous armed conflicts the vehicle for such recreation was the service club or man's own devices. This served only to medically incapacitate most, frustrate many and horrify others. Instead of building clubs at a base camp first and foremost perhaps we should have built tennis courts, handball courts, volleyball courts and secured running areas for unit sponsored recreational activities. These could have helped establish and maintain physical fitness, promoted teamwork and provided a healthy means of mental relaxation and diversion.

Taking all of these measures together in a balanced formula one can expect to minimize the fatigue associated with NOE flight. Fatigue will never be eliminated from the aviation environment completely, but failure to keep it under control is inviting disaster through mission failure, aircraft accidents and unnecessary combat losses.

Lastly and perhaps the most important is the preventive measure of greatest potential, that of continued surveillance. Careful observation of NOE flight planning, procedures and missions by commanders, safety officers and flight surgeons will help to identify factors that may be contributing to flying fatigue. In aviation these factors are many and varied. They require constant vigilance.

To guard against flying fatigue in NOE operations all should subscribe to these 10 preventive measures:

1. Know every aspect of the mission.
2. Know every aspect of the aircraft.
3. Train in both.
4. Become proficient in both.
5. Limit sortie duration.
6. Rotate sortie types.
7. Keep physically fit.
8. Participate in healthy recreation.
9. Get adequate natural sleep.
10. Identify and reduce fatigue producing factors.

Howitzers

Continued from page 3

no-wind capability of a helicopter with a T53-L-11 engine in and out of ground effect. Aircraft with T53-L-13 engines are capable of better performance particularly on days with a good wind. More exacting information concerning the L-13 engine can be found deeper in chapter 14.

Unfortunately, moving a howitzer with a UH-1H in most cases is challenged by the limitations of these later charts. The load may be attempted by referring to the sling-load limitations of 4,000 pounds and the ability of the aircraft as outlined in chart 14-3. The load carrying procedures from a 15-foot hover that should be used are carefully outlined in paragraph 14-11a.

Short slings should be used to take advantage of the hovering in ground effect lift assistance. One 11-foot and two 12-foot slings were used during the exploratory exercise. Generally an aircraft will be in ground effect within half a rotor diameter of the ground, nevertheless, takeoffs and landings should be made to take advantage of the prevailing winds. When operating at high gross weight and at low fuel level, care should be taken to consult the fuel endurance charts and the velocity not to exceed charts required for the mission. With the reduced fuel loads required due to the weight of the payload, aviation units must prepare to topoff their aircraft during the mission. An airmobile forward area rapid refueling point should be used. The site for this will be determined when considering the operation and the enemy situation. Standard hot refueling procedures would be used to speed the rapid turnaround of the lift aircraft.

Seasoned aviators with recent heavy slingload lift experience should be chosen to move the howitzers. In exploring the use of UH-1Hs, Company B aviators made training lifts using a fuel blivet filled with water to a weight equal to that of the howitzers. Slingloading procedure checks were developed and they are being added to the unit's standardization ride requirements. Careful premission briefings are needed to prepare the pilots to fly their aircraft near the machine's capability. Level takeoffs, wide turns and uniform landing descents are essential and aviators who choose to fly otherwise quickly learn that a howitzer does not want to turn as sharply as the aircraft.

An artillery ground guide and the crewchief provided directions to the pilot for the hookup, landing and load release. The guide—who wore a helmet with ear protection, goggles and a bright paneled jacket —employed standard arm and hand signals. The crewchief lay on the floor relaying the fine details of the operation to the pilot. It should be noted that the crewchief lying on the aircraft floor was not properly restrained by a seat belt.

This streamlined approach for hauling M102 howitzers is offered to provide a realistic means of meeting the requirements of a *combat necessity* although flight near the edge of the UH-1H's mission envelope may be necessary. In hotter weather at higher altitudes, the aircraft may be unable to lift the weapon properly. Then the aviator will have to decide if the aircraft is capable of the mission during his hover check. Commanders should consider taking advantage of this airmobile capability while realizing the aircraft's limitations.

The flexibility offered by this often discussed technique increases the capability of airmobile artillery while enhancing the professionalism of the supporting aviation units who must prepare to perform this mission.

Dual rated and 1,200+ hours, Major Herrick was a MACV battalion advisor to the 48th Infantry Regiment, aviator his second tour, ground commander with the 82nd Airborne Division in CONUS and is commanding 5th U. S. Army's unit of the year: B Company, 227th Aviation Battalion, 1st Cav

ARTS III Comes To Cairns

John Marusich
Staff Writer

The most advanced operational air traffic radar system makes the tension-packed job of the controller easier yet it provides much greater control accuracy and an improved margin for flight safety

THE FIRST AUTOMATED Radar Terminal System (ARTS) III to be located at a Department of Defense installation became operational on 28 May 1974 at Cairns Army Airfield Radar Approach Control, at the U. S. Army Aviation Center Ft. Rucker, AL.

Arts III is the most advanced computerized radar system in use today. Except for the facility at Cairns, all other (61) ARTS IIIs have been located or are programmed for Federal Aviation Administration (FAA) high density air traffic terminals such as Chicago, Los Angeles and San Francisco.

The initial prototype ARTS I contract was awarded to UNIVAC in 1963 for the FAA terminal at Atlanta; this system became operational in 1965. The following year the FAA programmed an ARTS IA automated air traffic control system for New York's Kennedy Airport. Upon completion, this control facility because of the ARTS capacity, combined the ATC functions of Kennedy, Newark and La Guardia airports into a single control location known as the Common IFR (instrument flight rules) Room.

The ARTS III at Cairns is an outgrowth of the above systems and of local efforts begun in 1972. In April of that year a site survey was completed after which a proposal was made for the automated radar system. By October a purchase agreement was made between the Army and the contractor through the Department of Transportation (FAA).

A programable data processor is the heart of the ARTS III system; the sophisticated equipment supplements the radar that has been used for years, now providing the controller immeasurable assistance, more flexibility and increased traffic capability. A data acquisition feature in the ARTS receives beacon video and control signals and generates range and azimuth data for processing. The data processor provides this information in usable form to the controller and also receives data from other terminals and air route traffic control centers as well as controllers within the

facility and produces the information displayed in the data block of the video display. A data entry and display subsystem electronically tags radar blips on the scope with alpha/numeric (luminous letters, numbers and symbols) data and also is the means by which the individual controller is able to enter display information into the presentation.

The data block automatically appears immediately northeast of the aircraft blip on the scope; the controller can relocate the block any place around the blip if it is to his advantage. Each controller receives only data concerning aircraft under his control. Without ARTS the controller was taxed with the mental strain of commiting to memory the identification of numerous blips as they inched or maybe meandered across his scope. With ARTS III the data block relieves him of this burden and allows increased attention to traffic separation and control functions.

Another valuable feature offers the controller the option to enter data for any blip on his scope whether under his control or not through an alpha/numeric keyboard (part of the data entry system) located at each control position; thus if he anticipates that a blip not controlled by him may have a bearing on his traffic or constitute a hazardous control situation he can instantaneously insert the alpha/numeric data by the blip to enable him to reconcile the situation. Each controller also can update the data block as the traffic clearances change.

Transfer of control between positions in the approach control is more positive now that blips are tagged with identifiers; previously the controller had to point to the blip on his scope so that the next controller would "see" the aircraft he was receiving.

The sources of information for the ARTS III include the flight plan filed with the ATC (air traffic control) center. Data from the center is automatically fed by computer to the destination terminal. When the aircraft comes within range of the terminal approach control radar the data block is programed to appear simultaneously with the blip on the scope. Controlled aircraft identifiers and continuously updated groundspeeds also are presented on the scope for the controller. If the aircraft has beacon Mode C altitude reporting capability, the ARTS will be able to display actual altitude in 100 foot increments. For aircraft lacking this equipment the controller can insert the reported altitude into the data block.

The system to the controller equates the improvement over the low frequency radio range by the invention of VOR (VHF omnirange), TACAN (tactical air navigation) and DME (distance measuring equipment) for the aviator; it makes the job a lot easier and enables much greater accuracy.

To prepare for the ARTS III at Cairns, three assigned data system specialists attended a 13 week data specialist's course at the FAA Aeronautical Academy at Oklahoma City, OK, where an ARTS III system is located specifically for indoctrination on its capabilities. Next, 10 additional Cairns personnel, including the training officer, attended a facility instructors course conducted by FAA at the same location. The purpose of this was to enable them to in-turn train the remainder of Cairns Approach Control people on the complete ARTS III operating procedure and capability and the operation of the programer (alpha/numeric keyboard) by which, as mentioned earlier, the controller enters or updates the data blocks.

The physical changeover to ARTS III at Cairns was accomplished without need for relinquishing control responsibility. During the light traffic early morning hours when modifications were made to the existing antenna to accommodate ARTS, traffic continued to be under positive control with the approach controllers employing the flight progress strips alone or what is known as the "manual system." This backbone of the ATC system involves only radio communication and updating the written information on the data strips; the controller then entirely relies on the adherence of aviators to flight rules and on his own expertise to ensure the safe and orderly movement of air traffic. This system though improved upon with radar and now ARTS is the basic "old reliable" to which centers, enroute and terminal facilities revert when other more sophisticated equipment should fail.

In addition to the antenna modifications, the Cairns control room radar consoles were replaced overnight with the ARTS consoles and associated data processing computers: This was possible only because of the close cooperation between the (UNIVAC) ARTS contractor and Army military and civilian personnel who meticulously planned the changeover and then worked as a team until its conclusion.

Cairns Army Radar Approach Control had at its highest level 162,000 traffic operations in 1969, the peak training year at the Army Aviation Center. Cairns Control is responsible for an area in excess of 7,500 square miles from the surface to 5,000 feet and two additional training areas when in use are controlled to 10,000 feet. The last 12 months traffic operations totaled in excess of 135,000. Without an increase in personnel Cairns Approach can with ARTS III improve on this figure readily and with a vastly improved margin for flight safety.

Surveillance At Its Best

Captain Nelson G. Peregoy
U. S. Army Intelligence Center
Fort Huachuca, AZ

WE MOHAWK pilots have been in a transition stage of changing from the OV-1B and C models to the all new OV-1D, and this has drastically changed the OV-1 company. In fact, I suggest that the OV-1D company can play a vital role in the future in support of night nap-of-the-earth (NOE) operations.

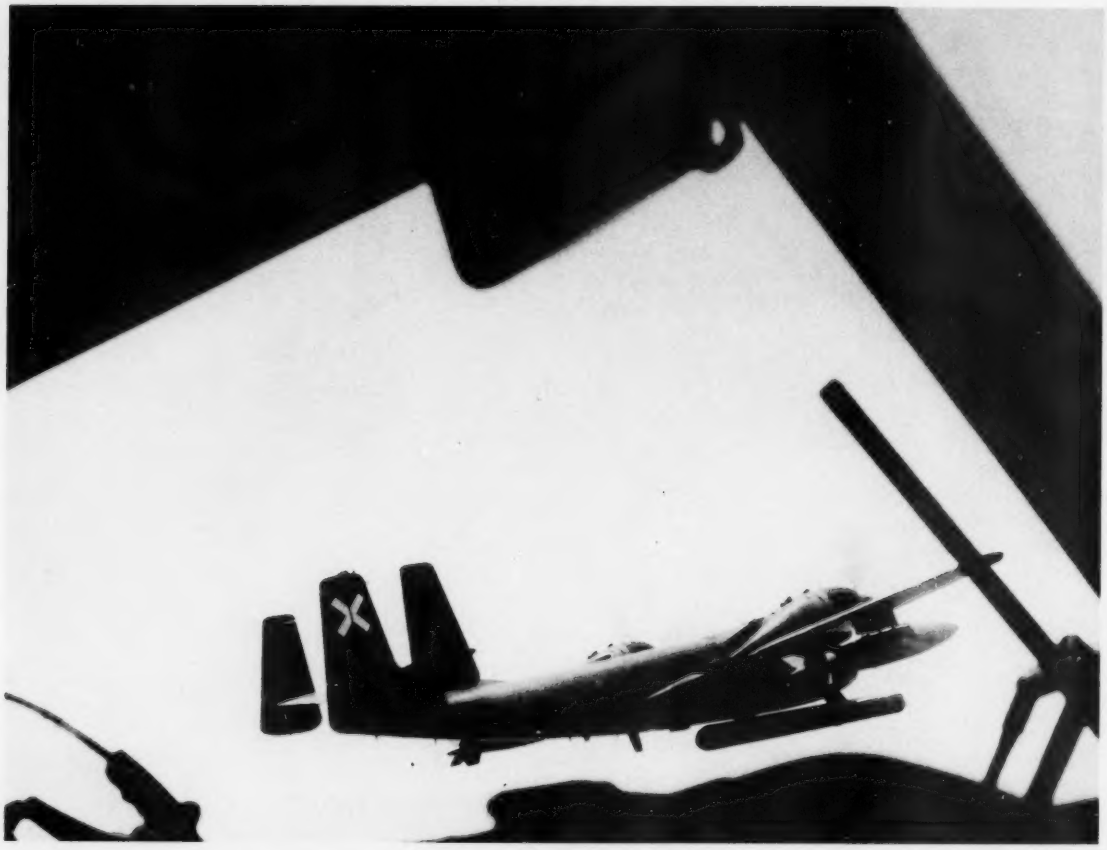
Even the old name of Surveillance Airplane Company has been changed to Military Intelligence Company (Aerial Surveillance). Currently, printed doctrine assigns this highly sophisticated semiindependent surveillance unit to corps, field army or separate task force units. It is capable of using a combination of aerial sensors to provide the supported unit with sustained combat surveillance and indirect target acquisition in an assigned area. This intelligence information can be provided in near all-weather conditions when flown from an airfield having a full instrument landing capability.

Yes, the Mohawk—especially the new D model—truly lends an invaluable capability to the Army's aerial surveillance capabilities. And, the OV-1D can play a vital role in night NOE operations. But before I dwell on Mohawk night NOE support, it is appropriate to discuss the OV-1D's surveillance equipment.

Information/intelligence gathering modes of the Mohawk include photographic, infrared (IR) and side-looking airborne radar (SLAR). Visual surveillance/reconnaissance is a vital adjunct to those modes. A complete battlefield surveillance system is affected when this company's assets are employed in conjunction with data processing and interpretation facilities found in division and corps military intelligence support units.

Although it is called a product improvement, the OV-1D is considered by many to be a new aircraft. Its external appearance is deceiving; it is very similar to the OV-1A, B or C models but it is a vastly improved Mohawk. The engine power is increased, an inertial navigation system (INS) has been added and even the IR and SLAR sets are so changed they do not even resemble their predecessors.

TACTICS
OUTLOOK



OV-1Ds will replace the older OV-1B and C model Mohawks

Photographic capabilities also have been expanded but the most significant change is the possible rapid reconfiguration of the OV-1D which permits it to perform the surveillance function of any previous Mohawk by taking advantage of the modular/palatized IR and SLAR systems. A well-trained ground crew can convert the aircraft to either the SLAR or IR configuration in less than an hour. Simultaneously, three camera systems can be installed or removed. Thus, the new Mohawk can be rapidly missionized in response to the supported unit's varying intelligence requirements.

The INS is a pilot's dream. This self-contained navigation and attitude-reference system is totally independent of aircraft maneuvers, weather conditions and terrain. The system in conjunction with aircraft equipment interface permits all-weather operations under instrument flight rule conditions. It provides a visual display of present position data in universal transverse mercator (UTM) coordinates of latitude-longitude coordinates during all phases of the flight. When a selected destination is approached or overflown the INS will display and/or freeze the geographic coordinates of the aircraft's position and provide approach and overfly warning light indications to the pilot.

To sum up, by coupling the INS to the autopilot the system will automatically guide the aircraft to and across up to 18 enroute checkpoints and a final destination. Range is limited only by the aircraft's fuel.

At any time during the flight the pilot can read bearing, range, required flying time to, and the distance to any of these programed or any other selected destinations. A data annotation system receives information from several sources including the INS and automatically prints full flight information on all sensor imagery, thus allowing exact pinpointing of any area of interest displayed thereon.

The OV-1D carries a nose-mounted forward looking panoramic camera specifically designed for a high-speed, low-flying aircraft. The camera is used to take

a sequence of photographs which provides complete coverage from directly below the aircraft to the forward horizon and through both lateral horizons. This camera is designed for daylight photography only.

There is a midsection fuselage-mounted still picture camera for vertical or oblique photography. This camera can be used in conjunction with an electronic flasher which attaches under the right wing of the aircraft providing a night photography capability. There also is a midsection fuselage-mounted vertical looking panoramic camera designed to provide horizon-to-horizon (lateral) photography. All three of the photographic systems have the capability of producing black and white, color, or color infrared photographs.

The new IR detecting set offers many advantages over the old. This set detects IR radiation from the terrain beneath the aircraft, converting this to a video signal which is displayed in near real time (immediately) on an 85 square inch TV-type console viewer in the cockpit and simultaneously records this video signal on film providing a permanent map for later, more detailed analysis. The operator has inflight selectable filters, making it possible to detect a wide range of targets.

Automatic target marking is available on the TV-type screen and on the recorded film. Resolution is greatly increased and the operator can freeze the moving image on the TV-type screen for closer evaluation of suspected targets. The field of view can be modified and slowed for expanded image detection. There is a built-in test facility and an automatic indicator to the crew of any major component malfunction.

The SLAR system emits a signal and receives a reflected return from the terrain below. A wide range of territory is covered from directly below the aircraft out to either or both sides of the flight path. It is capable of searching large areas of land or coastline.

The system is optimized for moving target detection and displays these targets simultaneously with a terrain display on film on the cockpit recorder-processor-viewer. The new SLAR set offers increased range, target detection capability and a larger viewing area on the cockpit recorder-processor-viewer.

As processed film passes across the lightable-type viewer, it is displayed side by side in two formats: a terrain type photo-radar map of the surveillance area and another of moving objects/targets in that area. The permanent hard-copy imagery is available for viewing in the cockpit only moments after the target is overflown and is returned for later, more detailed analysis. There also is a self-test capability allowing the operator to determine correct operation of the system.

In a low-, mid- or high-intensity warfare environment the surveillance equipment carried on the OV-1D Mohawk could produce vital up-to-the-minute planning information for NOE flight operations, night or day.

The SLAR system is designed to be parallel to, but flown behind, the forward edge of the battle area looking over on the bad buys. Hard-copy imagery produced by the system can be used to plan NOE avenues of approach for air assault missions. Photographs from the midsection fuselage mounted cameras can be used for detailed evaluation.

Possibly the best of all planning data could come from an OV-1 Mohawk contour flight along a flight path expertly navigated by the INS. Photographs could be produced from lateral horizon to horizon and directly below the aircraft to the forward horizon. This would produce photographs depicting exactly what a pilot flying NOE would see. Wouldn't you like to see this type of detailed flight planning information possibly taken minutes before your NOE flight?

Being a Mohawk aviator myself who has flown this magnificent flying machine in a hostile environment I have (like all other members of this elite group) come to love this performer.

In my opinion there is a definite need for this combat proven aircraft when flying the OV-1 Mohawk type surveillance missions—photographic, IR and SLAR.

I don't anticipate any argument from anyone who has strapped on this aircraft, launched and flown an IR mission low level at night over the enemy-held mountainous terrain of Southeast Asia. The same is true of those who flew the treacherous photographic missions over these same areas without cover of darkness on their side. It is as secure a feeling as can humanly be attained to know this particular aircraft is under you. We all knew that the armed ejection seat waited our command to thrust us from a crippled or disabled aircraft, if necessary.

Today's OV-1D aviators surely are equipped with the most sophisticated and finest of all Army aircraft. Together they can contribute significantly to NOE operations in a high-threat combat environment.

The author was assigned to the U.S. Army Combat Surveillance and Electronic Warfare School, Ft. Huachuca, AZ, when he wrote this article. He was a commercial pilot prior to joining the Army

Igor I. Sikorsky

Frank N. Piasecki

LTG Robert R. Williams

BG William B. Bunker

ARMY AVIATION

On 6 June 1974 Army aviation celebrated its 32d birthday. The day was highlighted at the U. S. Army Aviation Center, Fort Rucker, AL, by the dedication of the Army Aviation Hall of Fame and the induction of its first seven members. This article is a modification of the dedication day address made by Major General William J. Maddox, Jr., who commands the Aviation Center. Most Army aviation people are familiar with the terms used. The glossary box explains those terms with which you may not be familiar

ARMY AVIATION at age 32 is old enough to look back but young and vigorous enough to have a future with an unlimited combat potential. Regarding this future, two days ago General W. E. DePuy, who commands TRADOC, convened a meeting of all of the Army's center commanders here at the U. S. Army Aviation Center. We sat around the table in the main conference room to determine how we could employ aircraft to defeat an enemy tank brigade in a high air defense environment—in other words, how to apply combat power to a primary combat task utilizing only aircraft. In place of holding terrain, the pitch was to dominate that terrain and to fight our attack helicopter battalions and the air cavalry shoulder to shoulder in a set piece battle. The idea is to make Army aircraft central to the main action. That's the focus for the future and the way we are moving. But how does this relate to the past?

We started in 1942 with decentralization. I can remember flying in the 1st Cavalry Division when it had only 10 light fixed wing aircraft. Army aviation in those days was peripheral to the main action. Relative to terminology, we've come—in these 32 years—from fabric to FLIR; from carburetor heat to N_1 and N_2; from mag checks to hover checks; from the bungee cord to the bicycle grip; from the leather flying jacket to the Nomex flight suit.

Operationally, we've come from the Air OP (aerial observation post) to the hot LZ (landing zone); from road landings to pinnacle approaches; from the Grasshopper to the hunter/killer team—as a matter of fact, from the Brodie wire to the TOW wire; from flying sergeants to flying warrant officers and flying WACs (women soldiers); from the old air section to aviation companies, battalions, groups, brigades and even airmobile divisions.

At 32 we're primarily rotary wing. We're central to the main action; we carried the war in Vietnam for more than 11 years under the rotor blades of the helicopter. We're now a full fledged member of the combined arms team. We're still active and we're still growing.

I've highlighted mostly the changes between the past and today. But there is one thing that has not changed since 6 June 1942. That is the *Cub Spirit* which is very much alive and spawns an urgent desire to support and to prove ourselves in our work. We have the same enthusiasm, the same zeal, the same dedication, a strong trend to innovation and the same great bravery and heart. And we've had this *Cub Spirit* throughout each of these 32 years of our existence. That is how the past relates to the future and it is one of the chief reasons we are dedicating the Army Aviation Hall of Fame at Ft. Rucker, the center and home of Army aviation. That's why we're

LTG George P. Seneff, Jr.

GEN Hamilton H. Howze

LTG Harry W. O. Kinnard

COMING

In future issues the AVIATION DIGEST will feature each of the seven men inducted into the U. S. Army Aviation Hall of Fame

HALL OF FAME

here today—to pay tribute to our calling of 32 years and to those who served with us in this calling. We're here also to commemorate those who led us during this period.

Today, we're going to put a permanent new piece on the U. S. Army Aviation Museum—an Aviation Hall of Fame. Seven individuals who represent the decades of the 40s, 50s and 60s are being enshrined here. They are named and pictured on these pages. There are two from each decade and an additional candidate from prior to 1942. Each one is a rotary wing pioneer. They are aeronautical engineers and Army officers. They also are military and scientific philosophers and tacticians, battlefield captains and a logistician. They are all leaders and conceivers, all doers; these greats are the cream of a very large and a very fertile crop. All are men whose efforts were validated in the heat of combat.

At 32, yes, Army aviation is young enough to have its future ahead yet old enough to look back and proudly honor its deserving.

MG WILLIAM J. MADDOX, JR.
Commanding General
U. S. Army Aviation Center

GLOSSARY

TRADOC: acronym for the U. S. Army Training and Doctrine Command located at Ft. Monroe, VA.

fabric to FLIR: in the early 40s Army aircraft were covered with fabric; FLIR stands for Forward Looking Infra Red on today's aircraft (see "From Fabric to FLIR," June 1972 DIGEST).

carburetor heat to N_1 and N_2: carburetors on reciprocal engines of early Army aircraft had to be heated to prevent them from freezing and causing engine failure; N_1 and N_2 are integral power components of turbine engines used on today's Army aircraft.

mag checks to hover checks: piston driven aircraft required magneto checks to ensure that current is being generated for internal combustion ignition; turbine powered helicopters check their percent of power at a hover before continuing with a takeoff.

bungee cord to bicycle grip: bungee cords were used on early light aircraft as shock absorbers for landing gear; the bicycle grip refers here to the collective and throttle control stick on a helicopter.

leather flying jacket to Nomex: the lightweight Nomex flight suits of today offer improved protection over the leather flight jackets of the 40s.

Air OP to hot LZ: light Army aircraft used to observe the enemy and adjust artillery fire were called Air OPs; a hot LZ is a helicopter landing zone in a known or suspected enemy concentration.

road landings to pinnacle approaches: in the 40s and 50s light Army aircraft commonly landed on roads; today helicopters make approaches to and can land on high peaks of terrain.

Grasshopper to hunter/killer team: Grasshopper was the nickname applied to liaison aircraft during desert maneuvers in 1941 (see "The Army Aviation Story," June 1960 DIGEST); hunter/killer team is a combination of scout helicopters and attack helicopters employed in tactical operations.

Brodie wire to TOW wire: the Brodie Device was a World War II rig (named after its developer) consisting of four masts which supported a strong horizontal steel cable that provided a runway for landing and taking off (see "The Army Aviation Story," December 1962 DIGEST); TOW is a wire guided missile which can be launched from helicopters. The acronym stands for Tube launched, Optically tracked, Wire guided (see "1st Combat Aerial TOW Team: Helicopter vs Armor," February 1974 and "Germany Tests Airborne TOW," March 1972 DIGESTs).

Selected Effects Armament Subsystems

THE U. S. ARMY's SEAS program is well underway, as the Navy might put it. But, SEAS has little to do with the ocean or ships. SEAS is the acronym for Selected Effects Armament Subsystems. Recently, personnel at the U. S. Army Missile Command at Redstone Arsenal, AL, fired the historic first round of the program from a helicopter in flight.

The SEAS program is an effort to develop a highly effective aerial free rocket subsystem capable of longer ranges than now available. SEAS will be compatible with other ongoing Missile Command programs —HELLFIRE and Precision Laser Designators—to provide flexible aerial firepower on the battlefield of the future. Two prototype rockets have been designed, fabricated and are undergoing extensive testing at Yuma Proving Grounds, AZ.

The accompanying photograph shows Major General William J. Maddox, Jr., Commander of the U. S. Army Aviation Center at Ft. Rucker, AL, being briefed by Mr. Red Garner of the SEAS program office on the characteristics of the two developmental rockets. One of the rockets, the ANSSR, utilizes a revolutionary new concept for stabilization. It is spun up to a high rate by self-contained spin motors. The other rocket, AROW, is an advanced fin stabilized rocket employing a high impulse motor. Both techniques show promise in providing accuracy at long ranges and are being developed to allow effective fire from a hovering helicopter; a capability not now existent.

U. S. Army Training and Doctrine Command (TRADOC) is performing a Cost, Operational Effectiveness Analysis (COEA) to determine the most cost effective manner of satisfying the Army's requirements for the aerial rocket system of the future. If the results of that analysis show the developmental efforts have merit, the SEAS program will be subject to a Defense System Acquisition Review (DSARC) in the spring of 1975.

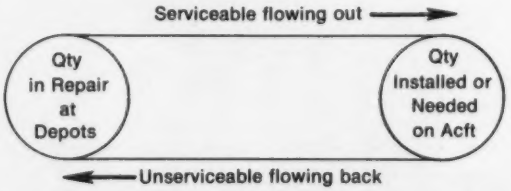
AVSCOM goes NORS to its customers

Vernon McGuire, DAC
Chief, Materiel Readiness Office
U. S. Army Aviation Systems Command

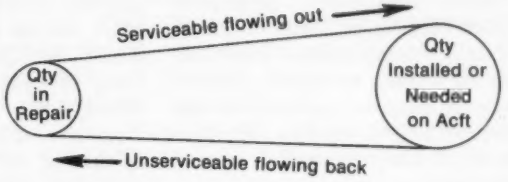
HEY, YOU OPERATIONAL flyboy types in the field, aircraft maintenance officers and supply support personnel—we at the U. S. Army Aviation Systems Command (AVSCOM) have some not operationally ready supply (NORS) items due in from you. We feel the support we are receiving from you is not as responsive as the support we are trying to provide on your request. I'm referring to the return of that unserviceable reparable item that we need back.

Let's look at it this way. On most of those reparable items, we only bought a certain quantity and are depending on the flow of these items back through our overhaul facilities to put serviceable stocks back on the shelf to supply you later on. In many cases when we at AVSCOM have to declare an item as aviation intensive management items (AIMI) not operationally ready supply support only, we've been NORS to you from our depot production line on the average of 3 months. Why do you think we send those frantic TWXs to the field to police up all of a certain item and get it back to us? The reason is you've either got our production line in a grounding condition or at least to a critical anticipated not operationally ready supply (ANORS) point.

To show you how it works, let's look at the supply of these parts as a continuous belt. Since we only bought so many parts, the flow of the serviceable parts out to you and the return of the unserviceables are represented by the belt itself. The two hubs or pulleys over which this belt moves represents at one end those parts installed on the aircraft and at the other end those on the production line being repaired at the depots.



Now think what happens if the bottom part of that belt stops or is slowed down since we do not backlog or stock "iron" for depot induction but depend on a continuous return flow of reparables to support the production line. That pulley on the left end which is the driver wheel becomes smaller and slows down, yet the one on the right stays the same size.



The results are the outgoing flow slows down, the installed quantity on your aircraft goes down and the needed quantity on your NORS goes up. What happens then? We at AVSCOM have two choices: First, we can try to get more money and authority to buy some more; or second, we can appeal to you to return the reparables. In either case, you are in for an extended dry spell. Either you have to wait out the procurement leadtime for the item or the return shiptime of the reparable item plus the overhaul production leadtime. We're both unhappy either way and much time and effort is wasted needlessly. The "buy more" solution is frowned on as it should be, so we both must concentrate on the second solution—expeditious return of those reparables.

We at the national inventory control points (NICPs) have 1 day to process your NORS requisition and the depot has, at the maximum, 2 days to pick, pack and ship the item. We, therefore, at AVSCOM challenge each of you, upon initiation of an NORS request, to look around your shops and facilities and ask yourself this question: Am I treating the return of all my reparables in the same expeditious manner that I expect to receive on this NORS request?

In essence, you are your own source of supply in the case of these reparables and, in the end, you determine whether you get a serviceable item or sweat it out. We at AVSCOM are just asking you to help us serve you better.

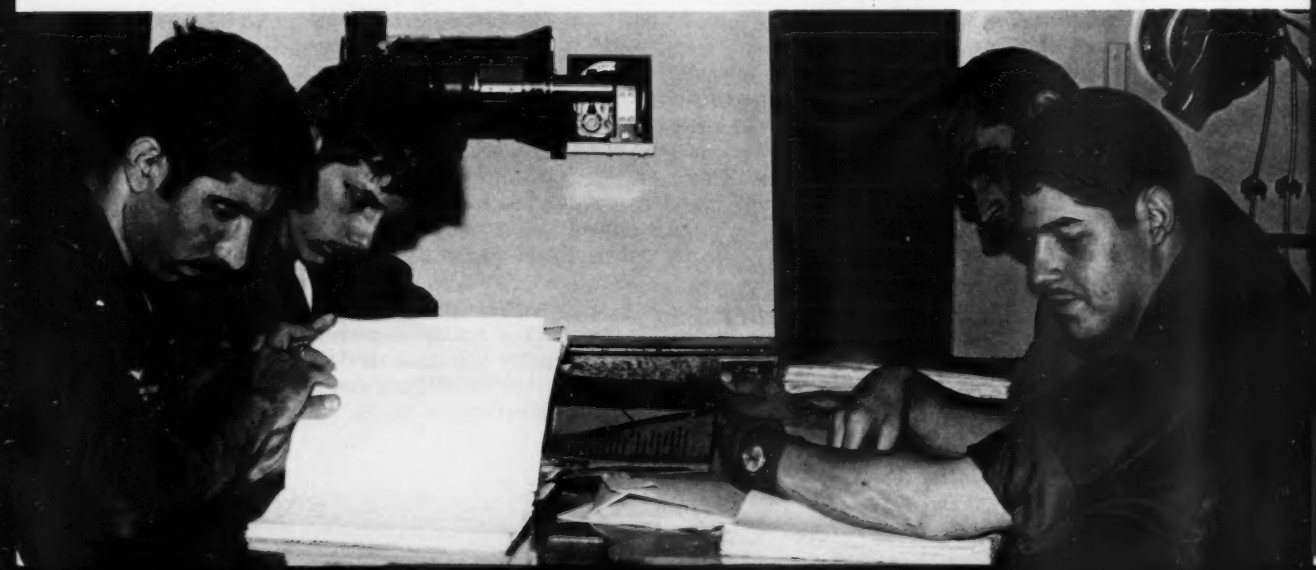
THE U. S. ARMY Environmental Hygiene Agency will present the Sixth Annual "Military Hearing Conservation" course for Department of the Army personnel, 23-27 September 1974. The overall objective of the course is to provide information to personnel responsible for the implementation and maintenance of hearing conservation programs. The course outline covers the following areas of instruction: physics of sound; anatomy and physiology of the hearing mechanism; physiological effects of noise; noise measurement and analysis; hearing protective devices including practice in fitting earplugs; engineering control of noise; audiometric techniques including practice in performing puretone air conduction tests; record keeping; interpretation of audiograms, and calibration and maintenance of audiometers; noise hazards in voice communication systems; aural rehabilitation; variables in noise-induced hearing loss; and procedures for establishing an effective health education program. Additional information can be obtained from the U. S. Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD 21010, AUTOVON 584-3797/3329.

MOS Development And Training

Continued from page 7

complex or detailed adjustment or system alinement. Due to these factors, maintenance personnel will be trained to quickly and accurately diagnose malfunctions and perform rapid module replacement, thereby providing for a maintenance response compatible with airmobile operations. Since success of the modular maintenance concept relies heavily on rapid and accurate fault isolation, training concepts have also been reevaluated. The past conventional method of training (part-to-whole) has largely been replaced by a functional context method (whole-to-part) approach. In this method a sequence is employed wherein the functional significance of each topic is firmly established prior to gaining more detailed knowledge. Training is organized so that the relevance of each to the main objectives (system, module or end item) can be demonstrated at the time it is taught. Teaching of principles of equipment functioning is linked closely with the teaching of diagnostic skills. The 672 career subfield of aircraft component repair has assumed many of the duties previously performed by the 671 career subfield. Replacement and inspection functions requiring special skills and tools have in most cases been assumed by this group. This transfer of responsibilities will provide the aircraft maintenance repairman with additional time to gain maximum efficiency in fault isolation and repair.

Third, training in "condition-monitoring" and quality assurance has been upgraded for the aircraft maintenance officer, aircraft repair technician, and technical inspectors. The Aircraft Maintenance Officer and Repair Technician Course (AMOC) has been systems engineered and restructured to incorporate maintenance test flight training previously taught in separate courses. It is expected that the restructured course will be implemented early in FY 75. Once implemented, the field will be assured of adequate maintenance test pilots since all eligible personnel will acquire these skills during their course of instruction. The technical inspector course has also been restructured to provide training in assisting the maintenance officers in performance of maintenance operational checks and test flights. The availability of these skills at all maintenance levels should greatly enhance mainte-



nance responsiveness.

As a fourth step, new training innovations have been implemented that will improve student training. One of the most significant to date has been self-pacing of the UH-1 (MOS 67N), CH-47 (MOS 67U), OH-58 (MOS 67V2T) and AH-1G (MOS 67Y) courses. This method provides for excellent student motivation and quality control. By using "go/no-go" evaluation points, quality of student output in all phases of the course is greatly enhanced. Other innovations include use of computerized simulators for trouble-shooting, programed texts, TV cassettes and numerous other audio-visual devices.

With the implementation of the modern volunteer Army concept, the retention and efficient utilization of noncommissioned officers and specialists necessary to run a complex, modern Army is a major challenge. One of the ways the Army is addressing that problem is the development of a better system to manage the many aspects of an enlisted man's career. This program, known as the Enlisted Personnel Management System (EPMS), will group functionally related MOSs into a common career management field (CMF). The Transportation School, as proponent for the aircraft maintenance (67) CMF, has been actively engaged in reviewing and revising the structure for this field. The new structure attempts to eliminate promotion bottlenecks, provide an equitable promotion opportunity in this CMF, and assist the Army in matching grades of soldiers and job descriptions with the actual position requirements. A detailed study was conducted for each aircraft maintenance MOS with the objective of consolidating skills where possible. The net result of this effort has been the recommendation to reduce MOSs in the 67 CMF by approximately 40 percent (see accompanying figure). All job descriptions have been revised to specify the exact duties of each MOS to simplify the requisitioning of the right person with the right qualifications for the job. With a reduced number of MOSs functionally grouped, training can be streamlined to better equip the repairman for his role in any future combat environment. The new proposed MOS structure has been tailored to maintain the current aircraft inventory and assume the support responsibility of new aircraft, (i.e., UTTAS, ASH and HLH) as they are introduced into the system. This proposal should eliminate future MOS proliferation and does not impose excessive skill demands on maintenance personnel.

A recent proposal has been made by the U. S. Army Ordnance Center and School to remove the Aircraft Armament MOS 35J, 45J and 45M from CMF 63 and place them in CMF 67. Manitenance of aircraft weapons systems is performed in conjunction with, and under the supervision of the organic aircraft maintenance personnel, and it has been recognized that it should be in the aircraft career management field. By placing the aircraft armament MOS within CMF 67 throughout their entire careers, their assignments will fall within the aircraft maintenance field and the grade progression will be within CMF 67, progressing ultimately to 67Z. With the continued assignment in the aircraft maintenance environment, the armament personnel are in a better position to gain the required experience leading toward the 67Z MOS.

These are but a few of the actions that highlight some of the more significant steps taken by the U.S. Army Transportation School to provide highly trained personnel to meet the maintenance responsiveness necessary for airmobile operations.

In this and the two preceding articles, I have outlined some of the efforts underway at the U.S. Army Transportation School that will benefit Army aviation. They are not the total projects underway, however, there is no doubt they will, when completed, provide the soldier in the field with an improved capability and the necessary modern materiel items to support Army aviation.

Proposed Career Management Field 67

Current MOS		Proposed
67B	O-1/U-6 Airplane Repairman)	Eliminate
67C	U-1A Airplane Repairman)	
67G	U-8/U-21 Airplane Repairman)	67B Airplane Rpmn
67H	OV-1 Airplane Repairman)	
67F	Airplane Tech Insp)	67H Aircraft Quality
67W	Heli Tech Insp)	Control Supervisor
67M	OH-13/OH-23 Heli Rpmn	Eliminate
67N	UH-1 Heli Rpmn	67D Util Heli Rpmn
67P	CH-21/CH-34 Heli Rpmn	Eliminate
67V	OH-6/OH-58 Heli Rpmn	67C Obsv/Scout Heli Rpmn
67U	CH-47 Heli Rpmn	67F Cargo Heli Rpmn
67X	CH-54 Heli Rpmn	67G HLH Rpmn
67Y	AH-1G Heli Rpmn	67E Atk Heli Rpmn
67Z	Acft Maint Supv	Remained the same
68B	Acft Turb Eng Rpmn	Acft Powerplant Rpmn
68D	Acft Pwr Train Rpmn)	68D Acft Powertrain
68E	Acft Rotor and Prop Rpmn)	Rpmn/NDI
68G	Airframe Rpmn)	68G Acft Structural Rpmn
68F	Acft Electrician	Remained the same
68H	Acft Hyd Rpmn	68H Acft Pneudraulics Rpmn
68Q	Acft Ground Sup Rpmn	New MOS in support of Acft Ground Support Equip

LET'S TAKE A CLOSE LOOK AT MAST BUMPING

Lieutenant Colonel James A. Burke

A CRITICAL condition can exist on helicopters having a teetering rotor design when the rotor hub makes inadvertent dynamic contact with the rotor's mast. This applies to all UH-1, AH-1 and OH-58 helicopters. If contact is sufficient to cause an indentation of the mast, the driving torque of the engine can ultimately twist or sever the mast. So let's take a closer look at the mast bumping phenomenon so that, as aviators, we can understand the ways to avoid conditions which contribute to excessive hub flapping leading to mast separations.

USAAAVS' records show that 47 mast separation in-flight breakup accidents have resulted in 181 fatalities and a cost of over $50 million (including training costs to replace the 87 aviator fatalities). Although in most cases the accident investigation efforts were plagued by uncertainties, lack of eyewitnesses and postcrash fires, the one common trend of occurrence was severe mast bumping, followed by mast separation in the static stop area of the main rotor hub. Admittedly, materiel failure of critical components may have initiated the sequence, but the cause of each catastrophic mishap was truly separation of the main rotor mast due to severe mast bumping.

Realizing that mast separation can occur, the purpose of this article is to help operators understand the major contributing conditions which "set the scene" for mast bumping. The following discussion concerning mast bumping was taken from a recent technical assessment of the problem by the U. S. Army Air Mobility R&D Laboratory in which the author participated.

Figure 1 is a schematic version of a simple teetering rotor. The rotor's design allows the main rotor blades to flap about a common pivot point to enhance the ride qualities and reduce the structural loads within the rotor system. Typically, the 12-degree flapping rotor is quite adequate for normal operations and has been conclusively proven by instrumented test flights and many years of production flight operations to be quite reliable and relatively trouble-free. However, it is important to note that the rotor hub can contact the rotor mast if the main rotor hub flapping is of the order of 12 degrees. So our job as aviators is really quite simple, mainly to operate our helicopters in such a manner that the rotor hub's deflection is well behaved to flapping values considerably less than 12 degrees.

Without dwelling on the exact technical details of the analysis, certain conditions contribute to excessive flapping. We can expect flapping to increase by values shown in table 1.

For reference, typically, a fully loaded teetering rotor helicopter operating at maximum gross weight, full forward c.g. at 90 knots cruise on a standard day, 2,000 feet, is characterized by rotor flapping values of 2 degrees to 3 degrees. However, should other conditions like those listed in III and IV of table 1 be superimposed, a rapid buildup in flapping can develop. For example, a simulation experiment of a

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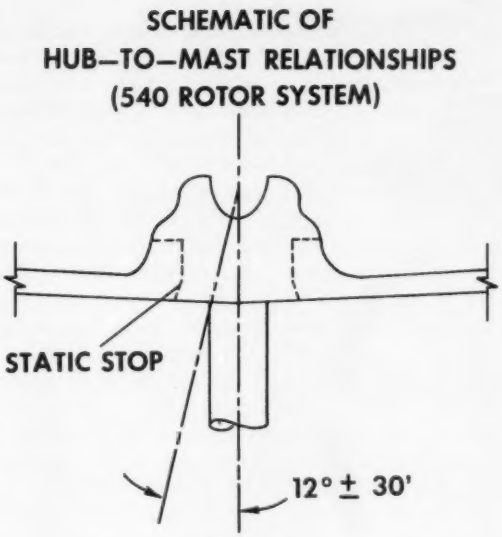

FIGURE 1

TABLE 1

GROUP	CONTRIBUTING CONDITIONS	TYPICAL FLAPPING VALUES
I	High forward airspeeds Low rotor rpm High density altitudes High gross weights	1°–2°
II	Turbulence	2°–3°
III	Sudden trim changes Center of gravity offsets High sideslip velocities–rightward direction	up to 9°–10°
IV	Low g loading	up to 12°–13° (or greater)

FIGURE 2
180° attack by HP enemy aircraft:
Enemy aircraft rolling in to fire.
Pink team takes evasive action

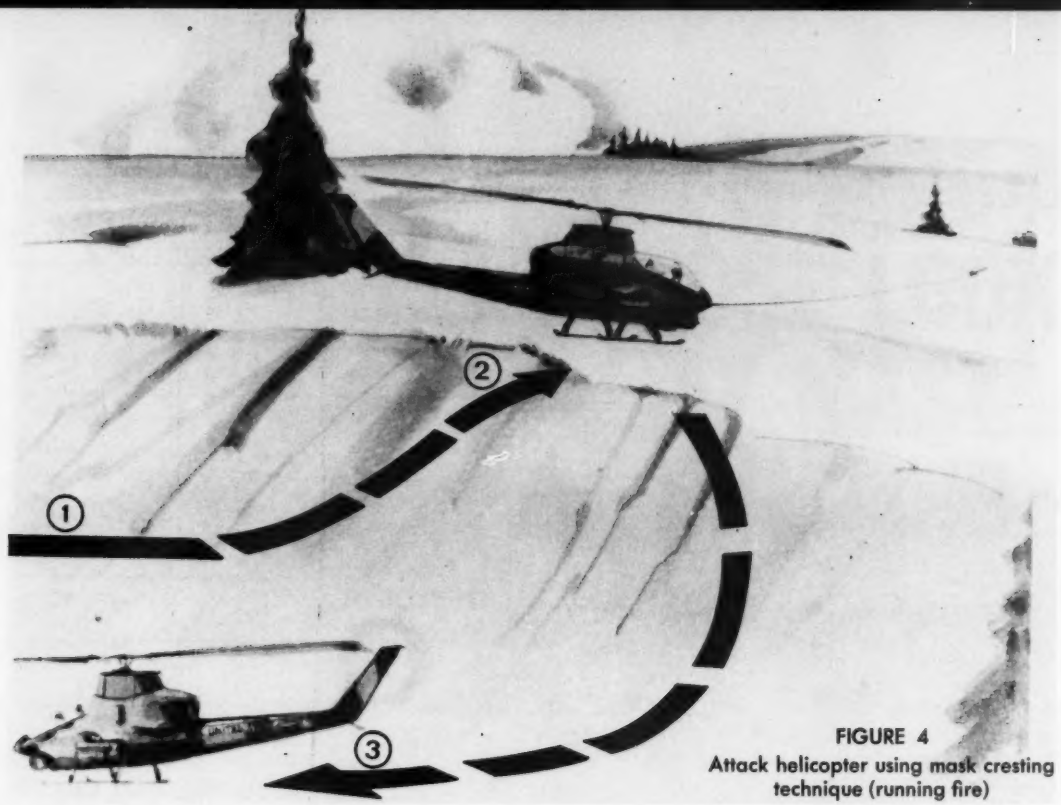

FIGURE 4
Attack helicopter using mask cresting technique (running fire)

FIGURE 3
Attack helicopter using mask cresting technique (hovering fire)

UH-1H has verified that a simple engine failure followed by an abrupt autorotation entry with a c.g. off-set of 6 inches (forward of allowable limits) caused flapping values in excess of 12 degrees. Had this been an actual flight situation, severe mast bumping would have destroyed the aircraft.

It is not commonly known that high sideward velocities (30 knots) *to the right* cause much higher flapping angles than sideward flights to the left. Specifically, right sideslips can develop as much as 9 degrees flapping as opposed to 4 degrees to 4½ degrees of flapping under the same condition when hovering or sideslipping to the left.

Category IV operations with low g-loadings seem to impose the greatest operational restraint to teetering rotors from a mast bumping standpoint. By design, this rotor requires positive values of g-loadings for cyclic control. Flight tests have generally confirmed that anytime we operate at g-loads less than 0.5 g the aircraft will start to show adverse signs of control response, and as the g-loading is reduced to approximately 0.2 g's, functional loss of effective cyclic control is fully developed. Hence, we must refine our techniques to ensure that our flight regimes sustain a positive g-load. This may be somewhat challenging in view of integrating advanced helicopter tactics into operational use. In looking at the advanced concepts of employing aerial scout vehicles and armed helicopters, certain tactical maneuvers like the ones shown in figures 2 through 6 should be prudently conducted with the thought in mind of retaining positive rotor control by flying with a reasonable positive g-load.

One way aviators can help prevent mast bumping is to operate within the c.g. boundary of the aircraft. For example, every inch the c.g. is displaced forward, the flapping values are increased by approximately 0.5 degrees. So, logically, a teetering rotor helicopter whose loading is such that the c.g. is displaced forward by 6 inches can expect an increase in flapping of 3 degrees. Consider the case of the c.g. located at 6 inches forward of normal limits (perhaps a typical combat-loaded situation for a UH-1H). Should the aircraft be subjected to an abrupt trim change (like a tail rotor failure), the flapping values are 3 degrees (caused from c.g. off-set) plus 9 degrees (imposed from the highly yawed tail rotor failure condition), resulting in a total of 12 degrees of flapping. Can we really get mast bumping from this situation? A preliminary simulation study conducted by the Air Mobility R&D Laboratory at NASA-Langley indicates that mast bumping will occur under this situation. Conclusion: Keep the c.g. within limits!

FIGURE 5
Enemy aircraft terminating firing run. Pink team diving under firing line

FIGURE 6
Should it become necessary to abort a mission, CAUTION must be exercised to limit low g regimes and cyclic excursions while attempting to sever the control wires and applying evasive maneuvers

Until further testing and improvements can be worked out to cope with unintentional mast bumping, we must tenderly and prudently operate our teetering rotor helicopters so that mast bumping does not impose a problem and will ultimately become as uncommon as the Black Plague.

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Publications and Graphics Division
U. S. Army Agency for Aviation Safety

"Hot" Refueling—what you should know

REFUELING OPERATIONS have always been accompanied by an element of risk. This risk, however, has been virtually eliminated by the enforcement of strict refueling procedures. In the past, most fire mishaps occurred because personnel became careless or failed to properly inspect and maintain servicing equipment. But times have changed. Today, the Army must have the capability to rapidly refuel helicopters in a combat environment. This means servicing aircraft "hot," with engines operating and rotors turning —a procedure that greatly increases the danger to both personnel and equipment.

Since January 1967, 30 fire mishaps occurred during rapid refueling operations. These mishaps resulted in injuries to 14 personnel, the destruction of five aircraft, major damage to 12 others and incident damage to an additional 13 at a cost of more than $2½ million.

In one instance, the pilot of an AH-1G was servicing his aircraft when the fuel shutoff valve stuck open. In desperation, he withdrew the nozzle from the filler neck to prevent overflowing the tank. Fuel gushing from the nozzle was then drawn into the engine inlet and ignited. The aircraft was destroyed. The fuel nozzle assembly used had notches, causing the valve to inadvertently lock in the open position.

In another instance, a pilot grasped a dripping fuel nozzle and approached his aircraft. When he touched the structure, a static discharge ignited the fuel. The aircraft was not grounded.

An explosion and fire occurred when another pilot flashed the running lights of his aircraft as a signal to his crew chief that the fuel tank was nearly full. Electrical arcing was the ignition source.

Accidents such as these not only injure personnel and destroy or damage equipment, but do so at a time these resources are needed most—when combat or combat support missions are in progress. To resolve the safety problems associated with rapid refueling, we must create a renewed awareness among aircrews of the hazards present, incorporate the safest refueling system possible and standardize the procedure to be followed.

We know we should ground aircraft before servicing them, and we know why. But we sometimes seem to forget that the possibility of a static discharge is greatest immediately after an aircraft is landed and while rotors are in operation. Yet, this is precisely when we begin rapid refueling operations. Consequently, it is not surprising that in seven of the 30 fire accidents reported, aircraft involved were not grounded.

Similarly, it is elementary that for any liquid fuel to burn, it must vaporize and have an adequate oxygen supply. Since gasoline is highly volatile, we are well aware of the danger posed when its vapors mix with air, and we treat it with respect. Because JP-4 is much less volatile than gasoline, we are often tempted to equate its lower volatility with increased safety. Actually, JP-4 is often far more dangerous than gasoline. The reason is simple.

At most temperatures, the concentration of gasoline vapors within a confined area such as a fuel cell will result in a fuel-air mixture that is either too lean or too rich to ignite. On the other hand, JP-4 vapors within a confined space will combine with available air to produce a mixture that is flammable over a broad temperature range. Any ignition source reaching it can cause a violent explosion and fire. Figure 1 graphically illustrates the flammable range of each of these fuels.

Presently, two rapid refueling systems exist: open circuit and closed circuit. In the open circuit system, servicing is accomplished in the usual manner by means of a standard fuel nozzle. In the closed circuit system, special nozzles and receptacles lock together

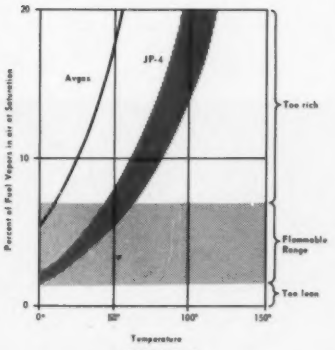

FIGURE 1

to seal fuel and vapors from the atmosphere. Although the closed circuit system provides a definite safety advantage, its reliability has not yet been established. In trial installations, leakage problems, fuel draining from cell vents and erratic operation of the automatic fuel shutoff have resulted in temporarily discontinuing its use. But the requirement for rapid refueling of aircraft in support of field maneuvers, combat testing and combat developments exists now. The only alternative is to use the open circuit system.

After completing a preliminary study of fire mishaps, the United States Army Agency for Aviation Safety recommends the following procedure be used as a guide when rapid refueling operations are to be performed:

1. Prior planning is a must. While fire prevention is paramount, other hazards associated with the operation of aircraft within a confined area must be considered. These include the possibility of meshing rotor blades, ground strikes, FOD and contamination of fuel systems by dust, sand and debris stirred up by rotorwash. Determining adequate spacing of aircraft, ensuring availability of firefighting equipment and properly

1

disbursing it (TM 10-1101, Petroleum Handling Equipment and Operation, stipulates that a 25-pound or equivalent CO_2 fire extinguisher must be conveniently located at each refueling site and should be manned during servicing operations) and establishing some positive means of communicating with aircrews must all be accomplished for safe operations—before the first aircraft is set down for refueling.

2. When an aircraft is on the ground, all occupants other than the pilot should disembark. To facilitate operations, personnel should have been briefed on procedures to be followed. Heaters and electrical equipment not needed should be turned off.

3. For maximum protection in case of fire, servicing personnel (usually the crew chief) should be properly dressed. Nomex flight suit should be worn with pants legs

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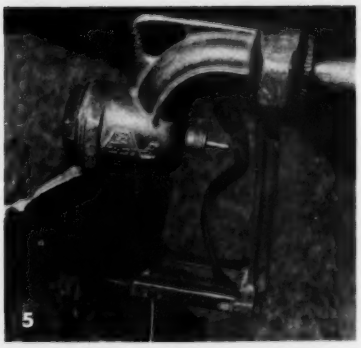
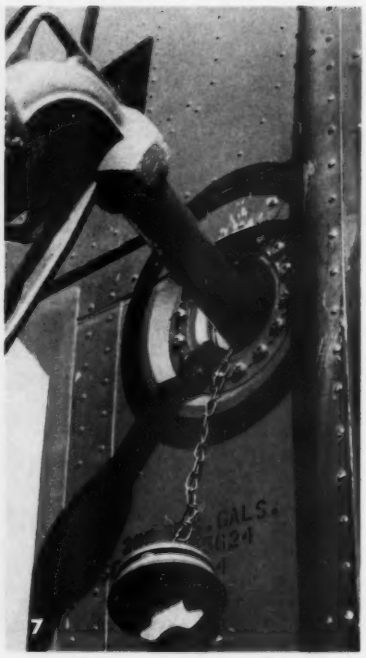




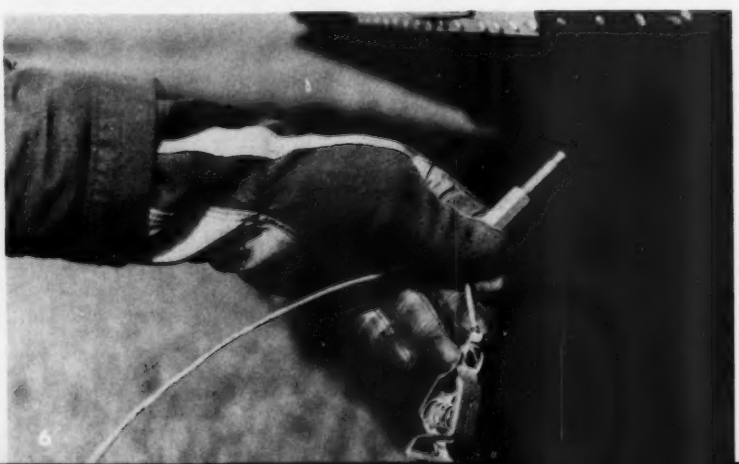
drawn snugly over boots, and sleeves over glove gauntlets. Collar should be turned up and helmet worn with visor down.

4. Aircraft must be grounded. In this instance, alligator clamp connects skid to steel grounding stake. When grounding cable is not fixed to grounding point, it should be first attached to ground and then to aircraft.

5. Fuel nozzle should not have notches that can cause shutoff valve to inadvertently stick open, and must have ground wire firmly attached to it. Protective cap (not shown) should be in place over nozzle outlet.

6. Before filler cap is removed, fuel nozzle should be grounded to aircraft.

7. With protective cap removed from nozzle and filler cap from tank, nozzle is inserted into filler neck. NOTE: On aircraft that incorporate a closed circuit refueling system, the gravity refueling port in the refueling receiver must be opened before a standard fuel nozzle can be inserted. Nozzle should be held with both hands, and body should be braced for sudden over-



pressure surges that may occur. When servicing is completed, fuel in nozzle should be allowed to drain before nozzle is withdrawn.

8. Pilot can assist refueling personnel by monitoring fuel quantity indicator and signaling him when indicator approaches full mark. While indicator cannot be depended upon to prevent overfilling of tank, it is a useful aid. Signals used must have been decided upon beforehand. While running lights may be kept on, they should not be flashed, nor should any electrical switches be actuated during refueling.

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9. When nozzle is withdrawn, protective cap should be installed over outlet, and gravity refueling port (if applicable) closed before filler cap is replaced. Fuel nozzle should be pointed down, and ground wires disconnected from aircraft and located so they cannot injure personnel or damage equipment.

10. With servicing completed and passengers and crew aboard, aircraft is ready to be moved out of area.

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USAAAVS

WHEN DOES AN INSTRUCTOR TAKE OVER CONTROLS?

Major W. W. Vatcher, USMC (Ret)

MAJ Vatcher was aviation safety officer with Marine Air Group 26 prior to his retirement

ACCIDENT FILES are replete with cases where instructors have allowed students to go too far before attempting to take control of the aircraft.

Here is a problem that no doubt manifests itself many times daily in every organization. Our psychologists tell us that mere recognition of a problem is the most powerful factor in its ultimate removal. To attempt an all-out assault on the problem here would be difficult to say the least, but perhaps we would benefit by merely bringing it into the open and conducting a general discussion.

The general feeling held by most instructors seems to be that while the student has the controls, the less yakking and less riding of controls by the instructor, the better. This idea is good in its basic concept, but to be effective it must be applied in specific cases rather than on a general level. General application to all students is apt to make the instructor a slave to the idea to the degree that when he should take the controls away from the student in a tight situation his reaction is not fast enough.

This hesitancy to assume control of the aircraft by the instructor could well be a result of experiences which most student pilots had in flight training. The instructor who was always on the controls and always talking was to be shunned like the plague, and few if any students ever went through the flight program without running into one of these characters. The student who has had such experiences is very likely to go to the other extreme when he finds himself in the position of instructor.

This seems to be true of most new instructors. With time and experience he soon learns the ropes and develops a more realistic attitude. So it is with the new instructor that this problem seems to prevail. By new instructor we don't necessarily mean "junior." Many of the senior officers who, upon finding themselves in the position of instructor for the first time or after a long absence from instructing, are just as

WHO'S WATCHING THE IP?

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EDUCATION AMONG primitive people was always directed toward ensuring the survival of the group, clan or tribe through training of the young in those skills and arts necessary to maintain life—the securing of food, clothing and shelter. The basic reasons for education haven't changed a great deal today but the methods of teaching have improved and the variety of subjects has greatly expanded.

Educators, whether they be called tutor, coach, teacher or instructor, must possess special skills. In addition to being well versed on their subjects, these individuals must be capable of imparting their information to others. Without this skill, they will be inept as educators.

Many educators are involved in teaching skills which they must be physically capable of performing. However, it is not always necessary that an individual be proficient at performing the skill he teaches. A classic example of this appeared in a newspaper article about swimming coach Sherm Chavoor.

Chavoor, whose swimmers have set 60 world records and 80 American records, coached Mark Spitz to his record seven Olympic gold medals. Spitz freely admits that without Chavoor's coaching he could never have done it. Yet, Chavoor cannot swim a stroke.

Likewise, an individual who is highly proficient at a specific skill may be incapable of teaching that skill to others, e.g., Mark Spitz might conceivably be a failure at coaching swimmers.

This also applies to Army aviators. The fact that an aviator has 1,500 accident-free flying hours doesn't necessarily mean he will be an efficient instructor pilot (IP). Careful consideration must be given to the selection of aviators for IP duty. The buddy system should never be used in selecting IPs. In addition to the individual's instructional and aircraft handling capabilities he should also have the

WHEN DOES AN INSTRUCTOR . . .

prone to this reaction as the junior officer pilots.

As a general rule, it is safe to say that whenever there is doubt in the instructor's mind as to the safety of a particular phase of a maneuver he should assume control of the aircraft. Now this statement may sound ridiculous to some because it sounds so trite and obvious. But the sad, well-documented fact is that not enough instructors believe it. There seems to be sort of a hypnotic effect on some instructors when confronted with a tight situation. Search your memory, you instructors, and see if you can't recall similar hypnotic spells on your part where if you had it to do over again there wouldn't be any hesitation. Then there are those occasions where you knew darn well it was going to be close but you just couldn't bring yourself to take over. You decided on the spur of the moment to chance it—to bull your way through. It's sort of the same kind of mixed-up thinking that many single-engine pilots use when they decide to try to salvage a lousy landing. It's just mixed-up thinking and in many cases an out-and-out case of inability to make a decision fast.

The real trick of course is to be able to anticipate rough situations just moments away and then take over. There should be no excuse whatever for an instructor allowing events to take their natural course when there is the slightest doubt in his mind as to the outcome of the maneuver.

In helicopter flying this tendency probably shows up mostly during autorotations or during landings where there is a high sink rate.

WHO'S WATCHING THE IP?

desire to instruct.

Aviators selected for IP duty must meet all the qualification requirements specified in paragraph 1-16 of AR 95-63. For an individual to be a successful IP, he should possess many other special qualities.

The IP must know his own capabilities as well as the aircraft capabilities and guard against exceeding either of them. He must know how to gain the confidence and respect of each student pilot (SP). The SP must know that the IP is capable of keeping him out of trouble while he is learning.

The IP must know the SP's ability for learning and gear his instructions accordingly because no two SPs will progress at the same rate. The IP must help build self-confidence in the shy SP and keep the bold SP from becoming careless and reckless. He must not become overconfident in the SP's ability. No SP's behavior is so reliable that he won't at one time or another do something completely unpredictable.

The IP must have patience and a reasonably agreeable disposition. If an SP makes the same mistake repeatedly, it could be he doesn't fully understand all phases of the maneuver. Perhaps another demonstration and explanation of the maneuver is necessary. If an IP loses his patience he can cause the SP to lose his self-confidence. Constructive criticism is necessary but must be administered tactfully. Likewise, a little praise goes a long way in building self-confidence.

The IP must be capable of recognizing problems in a student. Many problems can arise that will slow the SP's learning process and cause his performance to become erratic. The SP could be physically ill and on self-medication. He could be excessively apprehensive. He could be fatigued because of prolonged flights, tension unrelated to flying, rough air, discomfort from excessive heat or cold, or aircraft noise and vibrations.

The IP must be able to recognize fatigue in himself. IPs who are tired will unconsciously accept progressively lower standards of performance from SPs and this can lead to an accident.

Doing is the most effective way of learning and the IP must not be constantly on the controls with the SP. However, he must be constantly alert to every move the SP makes. He must know when to take over and have the SP relinquish the controls. (See "When Does an Instructor Take Over Controls?" page 39.) As a general rule, it is safe to say that whenever there is a doubt in the IP's mind as to the safe completion of the maneuver he must assume control of the aircraft immediately. Perhaps this sounds obvious but it's a well-documented fact that not all IPs believe it. USAAAVS accident files contain numerous cases where IPs let SPs go too far before taking control of the aircraft.

As you can see, the individual selected for IP duty must possess many special qualities to be successful. A good IP is watching the SP every instant, but who's watching the IP? After an IP is selected, what happens to him? He is required to possess a current instrument rating in the category aircraft in which IP duties are to be performed. And he must satisfactorily

In an autorotation, for instance, if there are trees between where the throttle is cut and the intended recovery spot, an instructor should be able to tell as soon as a descent is established whether or not the student is going to be close to the trees. If it is going to be close the instructor should either tell him to go around or take over himself. There is no excuse in this world to allow the autorotation to continue if there is any doubt at all about proximity to the trees. Yet this continues to happen almost daily. Ask any instructor if this isn't true. Along these lines students should initiate their own go-around if things aren't right. He has a responsibility here as well as the instructor.

There are many flight situations when the student isn't performing the maneuver just right the instructor can afford to let him keep the controls and learn for himself. The good instructor should learn to distinguish between these situations and give the student as much leeway as is consistent with safety of the aircraft. There is no better way to learn than to get fouled up and get yourself unfouled by your own efforts. But wrecking an aircraft isn't in this category, and if the instructor is worth his salt he won't allow you to get into such a mess.

It hurts a man's pride to have the controls taken away from him just when he thinks he has it wired, but the responsibility that goes with signing for an aircraft that costs several hundred thousand isn't small. Instructor and students alike should realize this, and students should give him the benefit of the doubt when he acts accordingly.

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complete a flight and written examination annually. It is apparent that many commanders think this is enough. They obviously think the IP is immune to emotional stress, fatigue, complacency, physical ailments and accidents, and need not be watched. The following accident briefs prove otherwise.

IP Repeater No. 1

An IP and SP were engaged in flying basic maneuvers of transition training in an AH-1G. The accident occurred during a 180-degree autorotation to the right.

At approximately 75 to 100 feet, the IP, sitting in the front seat, told the SP that the rate of closure was too fast and to correct for it. The SP attempted to do this, but was too slow to correct the situation. The IP came to the controls to recover the aircraft, but was too late to prevent a hard landing resulting in major damage to the aircraft.

The SP's grade slip folder for AH-1G transition established that he was extremely weak in autorotations and had previously received unsatisfactory grades from several instructors. The SP received an unsatisfactory grade on his postaccident checkride for autorotations.

Accident cause factors were listed as pilot error because the IP was too late with corrective action to recover the aircraft, and supervisory error because a weak student was scheduled with an inexperienced IP.

At the time of this accident, the IP had 1,107 flying hours in rotary wing aircraft. This included 58 hours in this model and only 2 of these 58 hours were IP time.

Exactly 1 month later, this same IP was involved in another major accident. He was flying an AH-1G from the rear seat and was demonstrating a high-speed low-level autorotation. During the maneuver the aircraft hit the ground with the heel of the right skid and the main rotor flexed down and severed the tail rotor drive shaft.

The cause of this accident was listed as poor pilot technique. The chain of events was initiated when the IP made his initial pitch pull at 15 feet and ran out of pitch before touching the ground.

At the time of this accident, the IP had flown an additional 79 hours in rotary wing aircraft. This included 77 hours in this model, with 73 of these being IP time. The SP was involved in a minor accident less than 3 weeks before this accident.

IP Repeater No. 2

This flight was an authorized routine dual training mission in an OH-23D. Plans were to work on simulated forced landings and confined area and pinnacle operations. The IP initiated the simulated forced landing at approximately 1,700 feet (ground elevation approximately 970 feet msl). The SP turned the aircraft to the south into the wind and located a suitable forced landing area. The IP determined, at approximately 1,400 feet, that the SP would be short of the selected area and took control of the aircraft. He then proceeded to demonstrate that by increasing airspeed an extended distance could be attained toward

the landing area. The IP intended to initiate a power recovery at 100 feet agl. Upon reaching this altitude he realized too late that he was rotating the throttle to the closed position. With a high rate of descent and excessive groundspeed the IP flared low and the tail rotor blades struck the ground. The main rotor blades severed the tail boom and the skid gear collapsed.

The established cause factor was IP error because he inadvertently turned the throttle in the wrong direction. A probable or suspected cause factor was failure of IP to monitor engine tachometer and maintain proper engine rpm while in autorotative descent.

Approximately 1 month later this IP was on a dual training mission in a TH-55A. Upon arrival at a sod touchdown area, the IP demonstrated an autorotation which was terminated with power. He then performed a second autorotation to a full touchdown. During this autorotation, groundspeed at touchdown was faster than the IP had anticipated and as a result a longer ground run than normal was experienced. The IP elected to demonstrate another 180-degree sod touchdown autorotation. This time, the turn to final approach was completed at about 200 feet altitude; the flare was effective, but possibly higher than normal; and the touchdown, though in a level attitude, was hard. After touchdown one main rotor blade flexed down and severed the aft section of the tail boom.

The cause of this accident was listed as IP error in flaring the helicopter too high and in applying excessive collective while too high, resulting in a hard touchdown.

IP Repeater No. 3

The IP and SP took off in an OH-6A for transition training. The SP performed two practice autorotations but used improper pitch-pull technique. The IP demonstrated a correct autorotation and then returned the controls to the SP and told him to try again. The SP performed the first part of the autorotation properly. At approximately 75 to 100 feet agl, he began his deceleration and at about 7 feet he pulled more initial pitch than was necessary. He continued to pull pitch at a slow rate, bleeding off rotor rpm to the point that flight could no longer be sustained. The aircraft touched down in a slight tail-low attitude, causing it to rock forward and back. The main rotor blade flexed down and partially severed the tail boom.

This accident was caused by the transitioning pilot placing the aircraft in a hazardous position during autorotation. Inexperience of the IP prevented him from recognizing the situation soon enough to react and prevent the accident.

A probable or suspected cause factor was lack of total flying experience of both SP and IP. Both IP and SP graduated from flight school approximately 6 months before this accident. At the time of the accident, the IP had a total of 38 flying hours in this model aircraft. Only 5 of these hours were IP time.

Two days later, this IP was involved in another accident during a transition training mission in an OH-6A. He received a *15-minute* postaccident checkride just before this accident.

Several confined area approaches and pinnacle operations were conducted. Three straight-in autorotational landings were completed by the pilot with the IP maintaining control (monitoring on the controls). The IP then took control of the aircraft to demonstrate a 180-degree autorotation. Upon touchdown, the main rotor blades flexed down and severed the tail rotor section.

The accident report stated that, while not definitely known, it was highly probable that the IP inadvertently lowered the collective pitch control during touchdown, thereby allowing the main rotor blades to flex down into the tail boom.

The flight surgeon made these comments on the accident: "We can only presume that pilot error was involved and can suspect factors of inexperience and apprehension from a recent accident as contributing factors. It seems unwise to train an aviator to be an IP when he has had such relatively little overall experience."

These are just a few of the cases on file where the same IP was involved in more than one accident in a short period. Numerous other cases show that IPs were involved in incidents and in a matter of days or weeks they were involved in major accidents. A careful study of these cases would probably reveal several reasons why the second accident occurs. No doubt, one of the more frequently established reasons would be residual apprehension stemming from a recent mishap.

Command responsibility does not end with careful selection of aviators for IP duty. The commander must be able to recognize problems in an IP just as an IP must be able to recognize problems in an SP. Who's watching the IP in your unit?

BROKEN WING AWARDS

FORT CAMPBELL, KY—Brigadier General Morris Brady (left), assistant commander of the 101st Airborne Division, presents the Army Aviation Broken Wing Award to CW2 John D. McWaters. CW2 McWaters was on a training mission when his AH-1G had a one-to-one vertical vibration during cruise flight at 500 feet agl. He reduced power and airspeed to try to eliminate the vibration, but it got worse. Recognizing the emergency as a feather bearing failure, CW2 McWaters performed a forced landing without damage.

NEW ORLEANS, LA—Colonel Curney J. Dronet (left), commander of the Louisiana National Guard's 256th Infantry Brigade, congratulates CW2 Ronald R. Freeman (center) as Captain Louis May, section commander, reads the Broken Wing Award citation. CW2 Freeman was on an OH-58A service mission in the vicinity of Fort Polk, LA, when his engine failed at 1,600 feet agl over a forest. He autorotated without damage to the only available landing area, a 100- by 150-foot furrowed field, surrounded by 50- to 75-foot trees.

WHO'S IN COMMAND?

YOU ARE DESIGNATED commander of a UH-1 scheduled for a cross-country flight. Your copilot is a general officer who has little flying experience. During flight planning, you are advised of deteriorating weather. You have a choice of either of two routes. One will take you over mountains; the other, along the seacoast. Because of the poor weather forecasted, you decide to follow the coastline. However, the general insists on flying over the mountains. He wants to save time as well as to familiarize himself with the terrain. Although you make several attempts to point out the hazards involved, the general remains firm. What do you do? Who's in command?

If you conformed to the general's wishes, consider yourself dead. While the example stated is hypothetical, it is based on an actual occurrence. That aircraft crashed.

The question remains: On any given flight, who has the authority to make all pertinent decisions relevant to that flight? Paragraph 1-17, AR 95-1, answers it this way: "The commanding officer, or his representative, will designate the pilot in command of each aircraft under his control prior to each flight or series of flights. This designation will be reflected in the flight plan, when used, or in the unit operations log. The commander places full responsibility on the designated pilot in command who is final authority for all aspects of the technical operation, servicing and hangaring or parking of the aircraft. . . . When two or more aircraft are operating in a flight or as a unit, the senior ranking aviator will be in command

of all aircraft, except when the unit commander specifically designates otherwise. . . ." The answer appears to be explicit. Yet, this single paragraph has been questioned more often than any other portion of AR 95-1.

To begin with, how do we define "technical operation" and what do we use as a common source so that the term does not become subject to individual interpretation? Is it intended to be all-inclusive, or does it set limits on the pilot's authority? What if a passenger, perhaps a rated aviator, should feel that the pilot is operating the aircraft in a manner detrimental to safety in violation of flight regulations? Has he any authority to intervene? If an SIP is giving an IP and his student a checkride, who is in command? The IP who is at the controls, or the SIP who is not? Also, what is meant by "senior ranking aviator"? Does this refer to rank, general flight experience or experience in type aircraft? Finally, if the pilot in command does have full authority to plan and conduct all phases of the flight, how does he handle a delicate situation such as that involving the general officer?

The U. S. Army Agency for Aviation Safety provides these answers: When the commander or his representative designates a pilot in command of an aircraft under his control, he gives that pilot full authority to plan and conduct all phases of flight as necessary to accomplish the assigned mission, and places upon him full responsibility to do so in accordance with existing applicable ARs and SOPs. His decisions are not subject to approval or disapproval of any passengers, regardless of their rank. However, should the pilot in command become incapacitated, physically or otherwise, during flight, and is incapable of performing his duties in a rational and responsible manner, it will be the responsibility of the crew to assume his duties and ensure the safe completion of that flight.

While paragraph 1-17 of AR 95-1 saddles the pilot in command with full responsibility for the safe conduct of a flight, it does not relieve the commander, or his designated representative, from his responsibility for making certain the aviator he assigns is fully qualified, current, responsible and capable of performing all the tasks required of him. Failure of commanders to ensure these qualities in a pilot when making assignments, and failure to be explicit in designating the pilot who is to be in command have resulted in accidents, some of them serious.

In one instance, the newest and least experienced pilot in the unit was assigned to test fly an OV-1 in marginal weather. When mechanical problems developed, the pilot, hampered by poor outside visibility, could not cope with the situation and a fatal crash resulted.

In another instance, the operations officer was not specific in designating the pilot in command when he assigned a CW4 and a CW2 on an IFR flight in a U-21. The CW2 thought the CW4 was in command and the CW4, in turn, assumed the duties of command pilot. When they reached their destination, they made an instrument approach and broke out of the clouds above minimum altitude. Visibility was at approach minimums with darkness, snow and low level runway light intensity affecting environment perception. On short final at approximately 50 to 100 feet, the aircraft entered a higher than normal rate of descent. Power was added, but the aircraft continued to descend rapidly until it struck the runway with the right main gear, and bounced into the air. The pilot then kept the aircraft airborne and continued to another airfield where he landed safely. Inspection revealed major damage to the center section, right wing, nacelle, landing gear, flap and fuselage. The CW4 was not current in the aircraft and overdue a standardization checkride. The operations officer was aware of these facts when he assigned the crew.

Obviously, pilots should not only be carefully selected for a particular mission, but their duties clearly stipulated. Similarly, when two or more aircraft are to participate in a flight, the unit commander should make certain the individual he wants to be in charge of the mission is specifically designated if it is to be someone other than the senior ranking aviator who would automatically have this responsibility. And senior ranking aviator means senior in rank, regardless of total flight experience or experience in type aircraft.

Finally, in matters affecting flight safety, how does one go about telling a general officer or other superior that he cannot honor some request relevant to a particular flight—a difficult thing to do. But maybe it isn't so difficult after all. Why not follow LTC (Retired) William A. Howell's lead, who as the first commander of the Executive Flight Detachment, and first Presidential helicopter pilot, often told President Eisenhower politely but emphatically: "No, sir, Mr. President."

If you have a question about personal equipment or rescue/survival gear, write Pearl USAAAVS, Ft. Rucker, AL 36360

PEARL'S

Personal Equipment & Rescue/Survival Lowdown

Protect Your Vision

One of the most valuable senses an aircrewmember possesses is his vision. Consequently, he should take necessary precautions to protect his eyes, especially on bright, sunlit days, to combat glare and spare the rods of his eyes for subdued light and night vision. Exposure to high intensity, continuous bright light breaks down the visual purple, a light-absorbing pigment in the retina, which decreases the ability of the eye to adapt to darkness and also interferes with daylight vision. Depending on the exposure time, as many as 6 to 8 hours may be required for this pigment to regenerate.

To preclude this, aircrewmembers should always wear the Army-authorized HGU 4/P impact-resistant lens, FSN 8465-753-6261. These glasses allow 15 percent of the natural light to be transmitted for safe flying conditions, and protect from color perception distortion. The right and left lenses are carefully matched for equal light transmission. In accordance with CTA 50-900, Line Item No. J61447, each individual on flying status or undergoing flight instruction and military air traffic controllers, including the ARNG, ROTC and USAR, are authorized one pair of man's spectacle type sunglasses. In the case of mobilization, Army aviators are authorized an additional pair of sunglasses.

As a note of caution, aviators should refrain from wearing commercial type sunglasses because (1) color tints often do not provide adequate protection from harmful rays of the sun, (2) poor optical quality often

degrades visual acuity and (3) lenses usually are not shatter resistant.

Another type of sunglasses which should be avoided are those which automatically vary the darkness of the lenses. The best protection for aviators is provided by those sunglasses transmitting between 10 and 20 percent of visible light. As presently developed, these visible density lenses allow too much available light to be transmitted to the eye.

It is also recommended that the clear visor be worn down with the sunglasses to provide maximum protection of the eyes from injury in case of an accident.

Disposable Oxygen Mask

We are constantly thrilled by the articles on rescue and survival gear and especially your pictures.

Of particular interest was the information on the disposable plastic oxygen mask, FSN 1660-902-5308, for the passengers in the rear compartment of the U-21A, which appeared in the December 1973 AVIATION DIGEST. We researched this stock number, because we had been ordering the same item under FSN 1660-592-5497 at a unit cost of 77 cents, as opposed to FSN 1660-902-5308 which has a unit price of $6.84.

To make sure, we put our hands on one each of these FSN items and found the following: When removed from the packaging, both disposable plastic oxygen masks were identical in appearance when placed side by side. Mask, FSN 1660-592-5497, was manufactured by Ohio Chemical and Surgical Equipment Company, and sold to the Army at 77 cents per unit price. Mask, FSN 1660-902-5308, was manufactured by Ohio Chemical and Surgical Equipment Company for Scott Aviation Corporation, Lancaster, NY, and then apparently sold to the Army at $6.84 per unit. This mask replaces the cheaper mask in the Army inventory according to the latest Army C-ML-A, and represents an 888 percent price boost.—SP6

The plastic face mask, FSN 1660-592-5497, costing 77 cents, is available through normal supply channels. Oxygen mask assembly, FSN 1660-902-5308, costs $6.84 and contains the plastic face mask costing 77 cents. In addition, it contains connecting hose, coupler and oxygen flow indicator. The oxygen mask assembly, FSN 1660-902-5308, provides all parts necessary for connecting to the aircraft passenger component oxygen system, while FSN 1660-592-5497 provides only the plastic face mask. USAAAVS recommends you continue to order the plastic face mask, FSN 1660-592-5497, for issue to passengers when all other parts of the oxygen mask assembly, FSN 1660-902-5308, are present and in good working condition. The supply depot has 1,200 plastic face masks, FSN 1660-592-5497, in stock to fill unit requisitions.

Returned Requisitions

I recently submitted requisitions through supply channels for the individual tropical survival kit, FSN 6545-782-6412, and the flash guard, FSN 6230-917-6692, for the SDU-5/E distress marker light. The requisitions were returned by Depot stating that the survival kit was not available for issue because it contains control items and that the flash guard has been deleted from Army inventory. Could you furnish more information concerning these items and also any information about the Army casualty blanket?—ASO

The individual tropical survival kit, FSN 6545-782-6412, is a component of the individual vest type survival kit, Line Item U72733, FSN 8465-177-4819. Personnel at the U. S. Army Aviation Systems Command, St. Louis, MO, were contacted and they indicated the survival kit was available for issue to units/individuals authorized the individual vest type survival kit. It is recommended that the survival kit be requisitioned again.

The flash guard, FSN 6230-917-6692, for SDU-5/E distress marker light has been replaced by a new flash guard. The new flash guard, FSN 6230-401-2285, snaps onto the distress marker light and has greater retainability. It is recommended that you request the flash guard using the new FSN.

The combat casualty blanket, FSN 7210-935-6667, is authorized by AR 40-61. The blanket is orange on one side and silver on the opposite side. The PEARL section of the May AVIATION DIGEST, page 47, carried an article on combat casualty blankets which you may find interesting.

USAASO Sez

The U. S. Army Aeronautical Services Office discusses

COPCOM: Controllers! The Controllers Operations/Procedures Committee (COPCOM) is still your best approach to good procedures. FAA Order 1110.58A, April 1972, can give you the complete COPCOM story.

Change 6 to ATP 7110.8C has added a new paragraph 6 entitled, "Recommendations For Procedural Changes," which encourages controllers to use COPCOM channels for their recommendations.

Army controllers are represented by the DARR NCOs located at the FAA Regional Headquarters, and by the ATC NCO at USAASO. Members, addresses, and area of responsibility are indicated below:

Representative	*Area of Responsibility*
SFC Ronald D. Gabriel Office of the DARR, FAA Western Region (AWE-591) P. O. Box 92007 Worldway Postal Center Los Angeles, CA 90009	**Northwest/Rocky Mountain/ Western**
SFC Claude L. Burdick Office of the DARR, FAA Great Lakes Region 2300 East Devon Avenue Des Plaines, IL 60018	**Great Lakes/Central**
SFC Bennie L. Adair Office of the DARR, FAA Southern Region P. O. Box 20636 Atlanta, GA 30320	**Southern**
SFC John T. Goodin Office of the DARR, FAA Southwest Region P. O. Box 1689 Fort Worth, TX 86101	**Southwest**
SFC Kenneth L. McElroy Office of the DARR, FAA Eastern Region Federal Bldg, JFK Intl Airport Jamaica, NY 11430	**Eastern/New England**

Army controllers overseas are requested to submit recommendations to:

**Director
US Army Aeronautical Services Office
ATTN: ACCQ-AS-ATC/SFC Mathews
Cameron Station
Alexandria, VA 22314**

These representatives will make *your* voice heard where it counts. Use them!

Army Aviation's *First Lady*

LAST JUNE the 4th, Army aviation graduated its first woman aviator. Second Lieutenant Sally D. Woolfolk received her wings that day at the U. S. Army Aviation Center at Ft. Rucker, AL, as one of the 25 members of Officer Rotary Wing Aviator Class 74-14. (On 8 June LT Woolfolk's surname changed when she married Captain Don Murphy.)

During graduation ceremonies Major General William J. Maddox, Jr., Commander of the Aviation Center, noted that during World War II many ladies flew for the Army, primarily test flights, ferry missions and the like. After the war this was largely forgotten. MG Maddox observed that today, however, we are stepping toward the 21st century with an increased awareness of the worth of the individual. The graduation of Army aviation's first lady aviator reflects this.

Dresses and flight caps don't seem to go together. But they're both in the wardrobe of Second Lieutenant Sally D. Murphy. Army aviation's first lady aviator...

...However, Lieutenant Murphy's flight attire is not out of place in the cockpit of a UH-1 Huey

To properly protect your eyes from sun and glare, PEARL urges all aircrewmembers to wear only the Army-authorized HGU 4/P impact-resistant lens, FSN 8465-753-6261.

This is the second of 12 back covers designed to show personal survival, rescue and protective equipment. Detach this cover for your bulletin board display of the more important survival and protective equipment available to aircrewmembers.

2 USAAAVS OF 12